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A History of the Pheasant in the Okanagan Region of Southern British Columbia

by D.J. Spalding and R.P. Stoneberg

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A HISTORY OF THE PHEASANT IN THE OKANAGAN REGION OF SOUTHERN BRITISH COLUMBIA

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Fish and Wildlife Branch

Ministry of Environment

Penticton, British Columbia

Fish and Wildlife Report No. R-4

December 1981

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ABSTRACT

The ring-necked pheasant introduced in the Okanagan Valley about 1910, increased to a peak population in the mid-1940's. The population dropped drastically from about 1947 until the early 1950's; then slowly increased to 1961. From 1962 to the present the population has been decreasing. The population decline of the 1940's has never been adequately explained although the severe winters of 1948-49 and 1949-50 probably magnified the loss of birds. The decline since 1962 resulted from rapid habitat changes occurring on agricultural land essential for pheasant survival. Nearly 50,000 ha of agricultural land have been lost, much going to housing developments, roads and industry created by the nearly 120,000 people living in the Okanagan. The loss of agricultural land has been amplified by a reduction in cereal and grain crops, an increase in hay and forage crops and intensive cultivation of the 14,000 ha of orchard. Pesticides, herbicides and sprinkler irrigation have placed further stresses upon the pheasant. The loss of essential pheasant habitat has lowered chick production through late summer and into the fall. By early October there are about 1.8 young per adult hen in the population. The present trend of a declining pheasant population will continue as the human population increases, causing further losses to pheasant habitat.

Keywords: agriculture, British Columbia, climate, habitat, hunter harvest, Okanagan, *Phasianus colchicus*, population, ring-necked pheasant

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FOREWARD

A note of explanation is in order for this Fish and Wildlife Report. This report was prepared as a technical document in 1970 by Spalding and Stoneberg, but languished in files rather than being published as originally planned. Now it has become apparent that this type of document has a historical value as well as its original technical merit: many of the original sources of data are no longer available. Recognizing these values as well as realizing that progress in the wildlife field depends upon the communication of findings, the report has been resurrected for publication.

The original manuscript has been changed only slightly. Most revisions were editorial so that the manuscript would conform to conventions of the technical publication manual. Measurements were converted to their metric equivalents except for the original figures and the General Weather Index, which depended upon Imperial units to make sense. Abbreviations in the Literature Cited section were revised to correspond to contemporary usage.

Content of the report was left unchanged. The original manuscript was reviewed adequately when it was prepared, and it did not seem worthwhile to repeat this process. Consequently, the report does not relate its findings to current literature but rather, to that literature up to 1969 regarded as relevant by the authors. Hopefully, publication of this report will stimulate a follow-up examination of pheasants in the Okanagan region.

D. Eastman, Co-editor,
Technical publications.

1981, December.

INTRODUCTION

The ring-necked pheasant[a], successfully introduced into British Columbia in 1883 (Carl and Guiguet 1958),has provided nearly 70 years of recreational hunting for British Columbia sportsmen. The demand for recreational hunting is now far greater than when the pheasant was first introduced but, to the dismay of sportsmen and game managers alike, ring-necked pheasant populations in all areas of British Columbia have declined noticeable in the last 20 years. This decline has been particularly evident in the popular and much-hunted Okanagan Valley.

Many scientific studies on the biology and habitat requirements of the pheasant have been carried out. Long-term population studies are fewer, but Kimball (1948) in North Dakota, Stokes (1954) on Pelee Island, Westerskov (1955) in New Zealand, Robertson (1958) in Illinois, van Nostrand (1963) in Nova Scotia, Mallette and Harper (1964) in California, Wagner et al. (1965) in Wisconsin,and Stokes (1968) in Utah, examined the relative successes or failures of introduced pheasants.

Results from several short-term studies of pheasants in British Columbia have been published: McTaggart-Cowan (1942) and Fowle (1944) examined the effect of pheasant depredations on market gardens in the Okanagan and on Vancouver Island, respectively; Benson (1950) and Rye (1952) both attempted to explain the sudden drop in the Okanagan population; Taylor (1962) analyzed the status of the pheasant in British Columbia during the early 1960's, and reference was made to the desirability of harvesting hens; Butler (1963) discussed the pheasant population decline in the Salmon Arm area; Spalding (1966) examined the effect of cock-only hunting in the Okanagan.

We have, in the following report, examined the rise and fall of the Okanagan pheasant population and attempted to explain the observed population changes through an examination of weather data, hunter harvest information,and changing land use practices.

ACKNOWLEDGEMENTS

Some of the information gathered for this study was obtained from discussions with several Okanagan residents, plus a variety of other sources. For those who assisted, but are not mentioned specifically, we extend our appreciation. We would like to give special thanks to Mr. Allan Brooks who kindly let us quote extensively from his father's (Major Allan Brooks, artist-naturalist) diaries. The Mackie family of Vernon gave us permission to use A. Mackie's diaries. Messrs. Jack Fowle, Alec Green, Percy Stead,and Jim Grant of the Vernon area assisted us whenever possible, while H. M. Laing, now of Comox, kindly checked his field notes for references to Okanagan pheasants. The Kelowna Daily

[a] Common names have been used throughout this report. Appendix D lists common names with their equivalent scientific names.

Courier, Penticton Herald and Vernon News allowed us free access to past copies of their respective newspapers, while the Pacific Nest Record Scheme kindly sent us available material on egg laying and hatch success of pheasants in the Okanagan area. The Vernon Fish and Game Club and the North Okanagan Naturalists' Club helped whenever possible. Staff members of the Fish and Wildlife Branch who assisted in collecting data were: A. Frisby, D. Steuart, A. Hames, R. Sheppard, H. Tyler (deceased), D. Hurn, I. Pickerill, J. Bone, H. Mitchell (deceased), E. Samann, N. Green and staff of the Summerland Trout Hatchery, D. Ellis (retired), and G. Anderson. Biologists E. Taylor, W. McLaren and P. Martin, initiated several of the early programs. To all these individuals and organizations we extend our sincere appreciation.

Dr. J. Bendell, Dr. P.J. Bandy, D. Sherman, R. Ritcey, and K. Mundy have kindly read the manuscript and offered many helpful suggestions.

GENERAL DESCRIPTION OF THE AREA

The Okanagan lies in the extreme south-central portion of British Columbia, and includes the drainages of the Similkameen, Okanagan, Kettle, and Granby Rivers. Pheasant populations in the study area are restricted to the valley floors and lower open grassland slopes originally dominated by Agropyron spp. with scattered Douglas fir and yellow pine. Precipitation is generally light (280 mm - 432 mm), summers are warm and January minimum temperatures range from -11° to -6°C. Soils, precipitation, and temperatures have favoured agricultural development which, in turn, has supplied the necessary habitat to support pheasants.

Three sub-areas were designated for the purpose of this study: (a) South Okanagan, from Peachland south to the United States border, including the Similkameen Valley; (b) North Okanagan, from Peachland north to Enderby; (c) Boundary, extending east from the Kettle River to Grand Forks (Fig. 1).

SOUTH OKANAGAN

The South Okanagan has a dry, mild climate with a mean annual precipitation of about 280 mm (Table 1). Total annual snowfall is less than 762 mm. Winters are characteristically mild, with below -18°C temperatures exceptional. Summers are hot (maximum daytime averages between 27° and 32°C and dry (about 76 mm of precipitation).

Pleistocene glaciation was largely responsible for the present topography of the Similkameen and South Okanagan Valleys. The ice sheet scoured and rounded the hills on either side of the valleys and, as the ice melted, glacial till was deposited. This was then sorted and redistributed by glacial streams, producing gently sloping terraces and benches along the valley sides. Glacial action resulted in depressions which are now represented by a chain of lakes in the Okanagan Valley. Later, streams flowing into the main lakes formed alluvial fans which, in some cases, further divided the lakes (Anon. 1967).

The dry valley bottoms support a bunchgrass, desert shrub vegetation (sage brush - greasewood) association. Climax grasslands still persist in some locations but have generally been replaced by invader species due to heavy grazing. The fine-textured soils at lower elevations have a long history of cultivation, facilitated by irrigation.

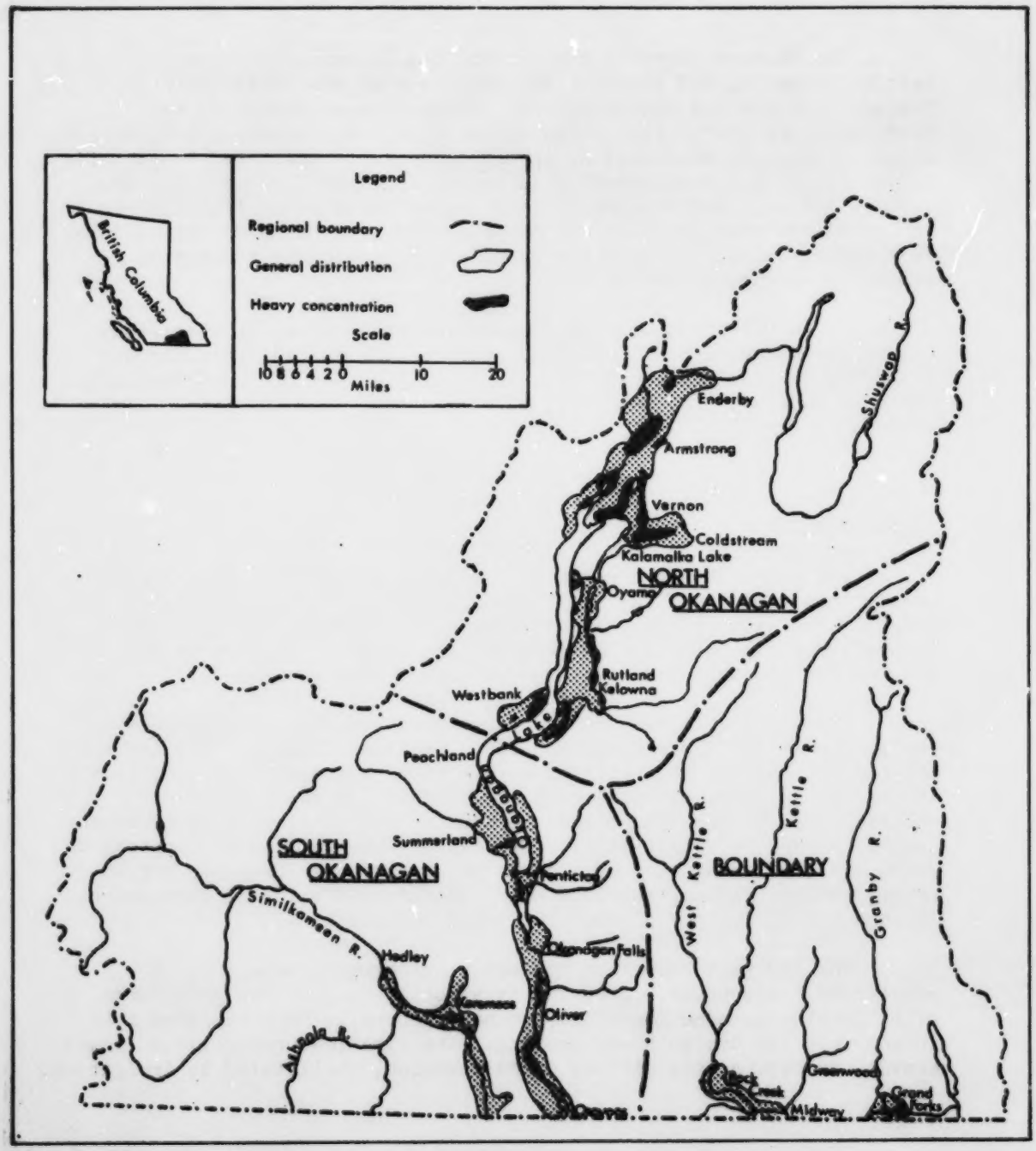

Figure 1. Pheasant distribution in the Okanagan.

Table 1. Mean seasonal and annual temperature and precipitation, in Boundary, South Okanagan and North Okanagan areas.

	Mean July max. temp (°C)	Mean Jan. min. temp (°C)	Mean annual rainfall (mm)	Mean annual snowfall (mm)	Mean annual total prec. (mm)
South Okanagan average (5 stations)	29	-7	213	695	283
North Okanagan average (3 stations)	28	-8	268	1145	383
Boundary average (2 stations)	30	-11	297	1382	436

NORTH OKANAGAN

The climate of the North Okanagan is influenced by air masses, mountain ranges, and proximity to lakes. Moist, warm, Pacific air masses, moving in an easterly direction, produce mild temperatures and an annual precipitation which increases from 317 mm in the Kelowna area to 432 mm at Armstrong near the northern limit of pheasant distribution in the Okanagan. Occasionally, polar air masses bring in dry arctic air while in the summer, dry hot air from the mid-western States has a strong influence.

The main surface features are deep, steep-walled valleys, fringed by glacially-rounded uplands. Two elongated valleys, containing Okanagan Lake and Kalamalka Lake, run in a north-south direction. The Coldstream valley extends in an east-west direction from the northern end of the main valley.

The rich soils in the valley bottom originally supported natural grasslands (Anon. 1967), and grasslands persist on the drier, exposed hillsides. Coniferous trees cover many of the hills in areas of high precipitation and extend down the slopes to the valley floors in some places.

BOUNDARY

This area is characterized by a series of narrow, north-south river valleys located within the Monashee mountain range. Although summer temperatures are comparable to the rest of the study area, winter temperatures are cooler. Annual precipitation is about 436 mm with an annual snowfall exceeding 1270 mm (Table 1).

The vegetation of the valley bottoms varies from open Douglas fir to yellow pine - grasslands (Krajina 1965). Settlement, cultivation,and stock grazing have localized in the lower valleys and native vegetation in these areas has been altered drastically.

METHODS

Game Commission reports, field notes of early naturalists, newspaper files,and interviews with long-time residents helped clarify the early history of the pheasant in the Okanagan.

Recent pheasant population data and hunter harvest information were collected as follows:

(a) Estimates of total harvest and seasonal hunter success data were obtained from the British Columbia Game Harvest Questionnaire Analysis, 1949 to 1970.

(b) Winter sex ratios were determined by flushing counts, carried out by two or more men working with dogs. Areas of known pheasant concentrations were examined in January or early February near Kelowna, Vernon and Oliver-Osoyoos.

(c) Crowing counts. Adult male pheasants were counted in the North Okanagan during the spring of 1963 and 1964 by recording the number of crowing pheasants heard at intervals 1.6 km apart and during 3-minute stops. There is no record of the early South Okanagan routes to 1964. In 1964,five routes were standardized: three in the North Okanagan and two in the South Okanagan and each was counted during early May of each year. Two-minute stops were made at 1.6 km intervals as we observed that pheasants frequently crowed twice during a 3-minute interval but rarely crowed twice during a 2-minute interval. Our goal was to record the maximum number of territorial males at each stop and we sampled each stop twice to achieve this. Each transect was traversed in one direction one morning and the opposite direction the second morning; the highest number of crowers heard at each stop was recorded as the population for that respective stop. Each one hour count began at one half-hour before official sunrise. Counts were not made if it was raining or if wind exceeded about 8 km p.h.

(d) Brood counts. August brood surveys were carried out in the early morning by two or more men with dogs, classifying all birds put up. These were done in areas of good cover and known pheasant concentrations. Nesting dates and early chick production was obtained from the Pacific Nest Record Scheme, a program in which volunteers throughout the Province recorded their observations. Okanagan pheasant nest records relevant to this study have been collected since 1958.

(e) Hunter checks. The pheasant season has traditionally opened on the 3-day Thanksgiving weekend in early October. Checks have usually been held on the first 2 days, although there has been some variation. Shooting was allowed from 0800 to 1600 h. during the period of our hunter checks, and the checks were done at the same time. until 1966, when, because of very light hunter traffic, they began at 1000 h and terminated at 1600 h. These checks recorded hunter numbers, hours hunted, and the numbers of pheasants harvested. Spur development

and/or the ability of the lower beak to support the weight of the bird indicated whether a pheasant was adult or young. Throughout this report a "young" pheasant refers to a bird of the year.

(f) Weather information was taken from the "Monthly Record of Meteorological Observations in Canada" compiled by the Meteorological Branch, Canada Department of Transport. We compared several weather stations in the Region and found that monthly trends in precipitation and temperature were similar for each station. We have, therefore, used the Summerland Research Station's weather records for all our calculations.

(g) Land area calculations, except those referred to in connection with agricultural crops, were determined by us with the aid of a planimeter. Agricultural land area was extracted from "Census of Canada Agriculture", compiled by the Dominion Bureau of Statistics.

RESULTS

EARLY HISTORY OF THE PHEASANT IN THE OKANAGAN

Success of first introductions and early harvest.

The present stock of pheasants throughout British Columbia, including the Okanagan, is a mongrel stock arising from the introductions of both the Caucasian and Mongolian pheasants. These have intermingled and most birds now show characteristics of the Caucasian race but some show strong characteristics of their Mongolian ancestors (McTaggart-Cowan 1942).

Pheasants were first introduced into British Columbia in 1882 when 20 were released near Victoria on Vancouver Island. These birds did not survive, but a second release on Vancouver Island in 1883 was successful. Releases continued in suitable habitat throughout the Province until 1957.

It was not until the first decade of the 20th century that birds were brought into the Okanagan. A. Green (pers.comm.) remembers that Mr. Price-Ellison released a small number of pheasants near Swan Lake, just north of Vernon, around 1910-11, and Jim Holt (1957 type-written report in Vernon and District Fish, Game and Forest Protective Association files) stated that one rooster and two hens were reported released in 1909, near Vernon[a].

The 1910 Report of the Provincial Game Warden stated "The possibility of acclimatizing pheasants in the interior has been given a good deal of attention this year. The experiment has been tried before and was not a success. However, in some districts, such as the Okanagan, it is well worthy of a good trial." The first release recorded by the Game Commission was one cock and five hens sometime during 1910 near Okanagan Falls (Williams 1910).

The 1910 introduction was successful and by 1913, Anderson (1913) reported "A few (pheasants) were seen at Okanagan Falls. I. Thomas reports the birds doing well and it is hoped they will endure the winter." A 3-day, cock-only, season was held in the South Okanagan in 1913 and the harvest was estimated to be 30 - 40 birds.

By 1914 the estimated harvest during the 3-day season in the South Okanagan was 80 birds. Introductions were made near Kelowna in this same year (Williams 1914).

Pheasants were reported established from Penticton south to the United States border by 1915 and the Kelowna introduction was doing well. Further introductions were made in the Salmon Arm, Midway, Grand Forks and Keremeos areas during 1915 (Williams 1915).

[a] The rooster was apparently killed by an Indian, who was fined $2.50.

From about 1915 to the early 1920's, successful introductions were augumented in all areas by further releases and the birds continued to increase their numbers and range, although the Keremeos population of south Similkameen was slow to increase.

The estimated harvest for the 3-day season in 1918 was 100 birds for the South Okanagan (Williams 1918).

Mr. Hamilton Laing reported (pers. comm.)"In 1922 the pheasant must have been rather low, for on my first day at Osoyoos as I hunted about to find Taverner's camp, I heard a cock crowing strongly in the meadows, ---there is no other mention of pheasants in my notes for that year."

By 1923 the Keremeos population had increased sufficiently to allow a season; by 1924 there were complaints from some South Okanagan and Similkameen farmers of crop damage by pheasants (Williams 1924).

The build-up of birds in the North Okanagan was slower than in the south, despite the early introductions. A. Brooks (unpublished diaries) first mentioned pheasants at Okanagan Landing on August 31, 1921 when he saw five pheasants feeding in the stubble. In December of that year he recorded only four birds at Okanagan Landing.

North Okanagan pheasant populations apparently increased rapidly during the early 1920's. On December 26, 1923, Brooks (unpublished diaries) counted 60 birds around Okanagan Landing and noted many pheasant wintering in the orchards during January, 1924.

The first season in the North Okanagan was held in 1924. Brooks (unpublished diaries) noted on November 1, 1924, "Pheasant shooting opened to-day, a regular bombardment between here (Okanagan Landing) and Vernon started soon after daylight. Pheasants were very numerous there". Brooks shot his daily bag of two cocks behind his house.

Pheasant population build-up.

From 1924 to 1930, pheasant numbers apparently fluctuated in all areas - some years they were reported up and others down. During the long, cold winter of 1927 - 28, they were fed in parts of the North Okanagan. Despite this severe winter, Hamilton-Laing told us (pers. comm.)that in the fall of 1928 he experienced excellent pheasant hunting in the North Okanagan. A general decrease in numbers was reported for 1929, and the winter of 1929 - 30 may have been hard on the birds as Brooks (unpublished diaries) wrote that during January, 1930, the north Okanagan experienced its longest spell of sub-zero weather on record.

Following the reported decrease of 1929 (and perhaps 1930), pheasant populations apparently began to increase. Plentiful pheasants and excellent shooting were reported from the Grand Forks area in 1931, as well as parts of the Okanagan. Brooks (unpublished diaries) reported

on October 15, 1932, "First day of pheasant shooting - shot four in one-half hour on L.A. ground.[a] Great number of birds seen."

Brooks frequently recorded large numbers of pheasants in his diaries throughout the 1930's; e.g., October 16, 1938, he reported seeing 75 pheasants on an area known as the Commonage near Vernon.

Population peak

This period has been difficult to determine accurately as records are scarce. However, the following account describes to the best of our knowledge, the years of abundance which probably extended from 1938 to 1946.

The Vernon News (October 10, 1940) stated: "Indications point to a near record season this year. ---Game Warden Charles Still --- reported this week that limit bags should be the rule not the exception". There was also a Vernon News editorial during October, 1940, welcoming pheasant hunters to the North Okanagan (such editorializing was common during the years of pheasant abundance).

Brooks (unpublished diaries) observed on May 14, 1942, that pheasant nests were plentiful. During January, 1943, he counted 102 pheasants in a 2-acre field near Vernon, and on a 7-mile census in the Okanagan Landing - Vernon area, counted 325 pheasants on February 24, 1943.

However, all was not bright in 1943. Brooks wrote that during January of that year "birds have been affected seriously by the extreme cold and snow-covered ground." And on August 20, 1943, (unpublished diaries) "....a poor increase in birds this year ---pheasants do not average more than two pounds." The October 21, 1943 edition of the Vernon News stated "Fewer pheasants than for many seasons rose before the shotguns of eager nimrods----".

By 1945, however, the situation appeared back to near-normal. In July of that year Brooks (unpublished diaries) reported "Pheasant and quail have large broods as weather at hatching time was very favourable." The only observations of pheasant populations in the South Okanagan are taken from Brooks diary, when he reported on May 20, 1945, that pheasants were abundant at Osoyoos.

The Vernon News (October 18, 1945) stated "Birds are plentiful this season in many districts ----. It is estimated that 600 or 700 birds were expressed or sent out of this city in other ways during the first three days of shooting." One week later (October 25), an editorial headed "The Best Yet" said, "From all points of view, the opening of the pheasant shooting season last week was the most successful for many years. ----Pheasant shooting is Vernon's best tourist attraction----".

[a] A large ranch near Vernon.

1946 was also a good year. Vernon News (October 17, 1946) again stated "Best hunting season yet indicated----". However, an editorial on the same date pointed out "Their (pheasant) numbers today are less than they were eight or nine years ago,----". More hunting restrictions and more predator control were requested.

The Decline

Although 1946 pheasant populations were still high, the 1946 Game Commission report (Anonymous 1946) stated "----a decline in the stand of pheasants is generally reported----" and all areas of the Okanagan Region, except the Vernon area, had reduced their daily bag from four birds to two birds. The daily bag in the Vernon area was reduced to two birds in 1947.

An article in the October 16, 1947, Vernon News called the Vernon area "America's finest hunting district"; an October 23rd article said the majority of hunters were able to complete their 2-bird bag, but an October 30th editorial was headed: "The Vanishing Pheasant."

The population decline had apparently begun.

Throughout the rest of 1947 the Vernon News carried several articles and letters decrying the shortage of pheasants. During late November, 1947, a special meeting was held in Vernon between the Vernon District Fish, Game and Forest Protection Association and Game Commission personnel, including Commissioner Cunningham (reported in Vernon News, November 20, 1947). At the meeting, Game Warden Clint Atwood prophetically remarked, "I do not think you will ever see the pheasants back again as before".

The meeting concluded that scarcity of food and cover, increasing human population, DDT sprays, and increased predation had caused the decline.

A letter to the editor (Vernon News, November 27, 1947) from Austin Mackie, well known North Okanagan naturalist, pointed out that pheasants had not only declined in the Vernon area, but also from Salmon Arm south to Osoyoos. He recorded in his unpublished diaries during 1947 that "In South Okanagan ---pheasants very scarce. Home area (Vernon) pheasants far fewer".

Public concern forced a complete closure of the pheasant season in the Okanagan Valley during the fall of 1948. The Vernon News, in an editorial on September 23, 1948, emphasized the shortage of birds during that year and a veiled suggestion was made that unless the Game Commissioner could alleviate the situation, resignations were in order.

The winter of 1948-49 was of moderate severity and the Game Department was urged to feed pheasants.

Although the pheasant population had apparently started to

decline in 1946 or 1947, birds were still numerous during the winter of 1949. On February 3, 1949, the Vernon News carried the results of a count conducted by Game Warden Atwood who, in the Coldstream Ranch - Kalamalka Lake - Vernon - Armstrong area, had observed about 4,630 pheasants, and he estimated the Vernon district population at 8,000 - 10,000 birds (Vernon News, February 24, 1949).

The worst was yet to come. The winter of 1949-50 was very severe and many birds died. A 1950 winter census of pheasants was conducted in the Vernon area, probably during January or February (we assume the area covered was the same covered by Atwood's 1949 February census). During this census only 717 birds were counted, compared to approximately 4,630 counted the year before (Anon. 1950).

The Vernon News (October 26, 1950) stated "From comparative plenty to insolvency in five years. That is the record of British Columbia's game management with respect to that fine upland game bird the cock pheasant---. The decline of the pheasant in the Vernon area is a disaster, nothing less---. The point has been reached today where the pheasant is literally close to extinction."

Luckily, 1950 saw the end of the sudden, drastic, and largely unexplained decline. By 1952, A. Mackie (unpublished diaries) was able to report that pheasant numbers were increasing. Ensuing years saw a slow but erratic increase until the early 1960's.

Summary

This previous section can be briefly summarized as follows:

About 1910 - pheasants first introduced.

1910 - 1920 - population low, but introductions continuing.

1920 - mid-1930's - populations generally increasing.

About 1938 - 1946 (?) - populations peaked.

1947 - 1950 - populations declined rapidly.

1951 - early 1960's - slow build-up to a level below that of the early 1940's.

Early Studies

(a) Too many pheasants, as well as not enough pheasants, have created problems. The Penticton Herald, February 10, 1912, stated that a further offer of pheasants from the Game Commission for the Penticton area had been refused because of possible losses to agricultural crops. Beginning in 1912 and reaching a peak in the early 1940's, farmers became increasingly alarmed about crop damage by pheasants.

During 1941,several steps were taken. In January, 1941, the Vernon and District Fish and Game Protective Association presented a resolution to the British Columbia Game Commission asking for a 3-day hen pheasant season in areas of crop damage caused by pheasant depredations. The Game Commission instituted a seasonal bag of 20 birds (from 15 in previous years) during 1941,and a 2-day hen pheasant season was initiated in the Coldstream area of the North Okanagan during the same year.

The British Columbia Interior Vegetable Marketing Board, at their 1941 Annual Convention in Kelowna passed the following resolution: "That the Government be asked to undertake the entire elimination of pheasants in districts where the majority of farmers complain of serious damage to crops."

The Game Commission felt that such a move was too drastic but they did agree to issue permits allowing farmers to kill offending pheasants causing crop damage. There is no record of the success or failure of this latter move.

Finally, in a determined effort to establish the effect of pheasants on farm crops, the Provincial Game Commission in cooperation with the University of British Columbia enlisted the aid of Dr. Ian McTaggart-Cowan to carry out a study in the Vernon area. This was completed in 1942. Dr. McTaggart-Cowan concluded that on his study area of 6,960 ha there was a fall population of about 11,600 pheasants which dropped to an over-winter population of 6,000 birds. Weedseeds constituted 44% of the annual food, and the only agricultural crop to suffer was tomatoes. Tomato crop losses were estimated to reach $8/ha in some areas. However, as some tomatoes were usually left to rot in the fields it was concluded that pheasants did not cause a significant economic loss to local growers (McTaggart-Cowan 1942).

During this same study,McTaggart-Cowan (1942), who was studying the area when the pheasants were at their peak numbers, could find no evidence of a food shortage. "No attempt is made at clean cultivation, so that hedgerows, vacant fields, orchards, irrigation ditches, and many cropped fields present a luxuriance of weed-growth with attendant food and cover within easy cruising radius of cultivated crops."

In addition to actual crop loss,pheasants have produced one other area of concern between the farmer and the hunter. This began soon after the first successful releases, and involved friction between the land-owner and trespassing hunters. Brooks (unpublished diaries) noted on October 26, 1923, that his pheasant hunt at Summerland was not

as enjoyable as in the past as the farms were all posted.

Friction between the land-owner and hunter has continued ever since, and more land is posted each year.

(b) Following the pheasant population decline,two studies were initiated to determine the cause or causes of this decrease in numbers.

(i) W.A. Benson's (1950) study attempted to evaluate the effect of several factors, including orchard sprays, upon pheasants. Inclement weather, reduction of cover, increased hunting pressure (which had doubled between 1937 and 1947),and predation were regarded as having little or no effect on the decline. Mortality due to farming practices (mowing, sprinklers, etc.) caused some losses, but did not explain the major population drop. New pesticide sprays introduced in 1947 were believed by Benson to have accelerated the decline, but were not designated as the major cause. Disease was regarded as a possibility but confirmatory data were not available. A population decrease following a successful introduction (observed in several species when introduced into an environment previously unoccupied by that species) and population cycles were both ruled out as definitive causes. By 1950,the orchard environment was regarded as unsuitable for nesting pheasants: in 19 ha of alfalfa, oat and hay fields, Benson located 29 pheasants nests, but only seven nests in 126 ha of orchard.

(ii) D. Rye (1952) also examined the pheasant decline and the several factors that Benson (1950) had investigated. Because Rye's study was the second in the area his conclusions are a little more definitive. Although both Parathion and DDT were recognized as potential threats to pheasants, they, with several other insecticides examined, were not regarded as major causes of the decline. A trend towards sprinklers combined with more intensive cover treatment within orchards, had rendered the orchard habitat inhospitable for pheasants; this was felt by Rye to be one of the critical limiting factors in the Okanagan. He indicated that the effect of weather could not be precisely determined; predation, especially by domestic dogs and cats, caused some losses; hunting had increased but was not a limiting factor. Cyclic fluctuations and recession of an introduced species were also ruled out.

By the early 1950's, there was no commonly accepted cause for the rapid decline of the Okanagan pheasant population. Nature lovers, hunters and non-hunters, were in an uproar; perhaps, although no evidence is available to substantiate this, many farmers were relieved.

PRESENT PHEASANT DISTRIBUTION AND RELATIVE ABUNDANCE

The distribution and relative abundance of pheasants in the Okanagan are illustrated in Fig. 1. Pheasants are found on about 114,640 ha in the three sub-areas: 11,680 ha in the Boundary, 33,080 ha in the South Okanagan, and 69,880 ha in the North Okanagan. We have used the designation "heavy use" as a largely relative and subjective evaluation of abundance. Crowing counts, hunter harvest, plus general observations by ourselves and of other members of the Fish and Wildlife Branch were utilized to designate heavy use areas. Areas of heavy use now occupy about 17,600 ha: 1,200 ha in the Boundary, 2,600 ha in the South Okanagan and 13,800 ha in the North Okanagan.

AGRICULTURAL AND HUMAN POPULATION CHANGES

Agriculture

Cattle ranches, wheat farms, and orchards were all started in the Okanagan Region during the late 1800's. Generally, throughout the early 1900's the economy was based on agriculture and the Region attracted an increasing number of ranchers, farmers and orchardists. This development reached a peak in the late 1940's and the early 1950's, and by 1951, there were over 284,400 ha of farmland and 5,265 operating farms.

Crop acreages and the changes in acreages devoted to several agricultural uses are shown in Appendix E and Fig. 2. The changes in total farmland, human population, forage and grain production, forest and improved farmland acreages all may have influenced pheasant populations.

Two developments took place in the 1940's which had a profound effect upon agriculture. The first of these was the introduction, in 1945, of the aluminium tube sprinkler system, as opposed to ditching or flooding. Now (1973), virtually all irrigation is done by sprinklers. This change-over to sprinklers initiated a move from dry-land grain farming to more profitable hay and pasture crops and facilitated agricultural development in areas previously difficult to irrigate. Forage and pasture acreages have increased from 17,112 ha in 1921 to the present (1966) high of about 48,800 ha.

The second significant development of the 1940's was the introduction, in 1947, of new pesticides (including DDT) to control insect damage to agricultural crops. These pesticides have enabled a marked increase in marketable crop production per acre.

Total land devoted to agriculture reached a peak in 1951. By 1966, 15 years later, the Region had lost about 51,240 ha of agricultural land and nearly 1,000 farms, mainly to urban development.

The negative effect on pheasants of the outright loss of agricultural land has been magnified, as total improved land (land used for cereal crops, market gardens, vineyards and small fruit) increased from 42,400 ha in 1921 to 78,640 ha in 1966. We believe this increase in improved land represents a further habitat loss to the pheasants. Brush borders, fence rows and rough areas of good cover have been removed, and the constant grooming of this improved land to enhance crop yields (cultivation, insecticide and herbicide spraying, sprinkler irrigation) has lowered the carrying capacity of the land to support pheasants.

The increase in yield-per-hectare is best exemplified by an analysis of production in the 14,000 ha of orchard (Fig. 3). This in itself is not adequate to support our belief that increased yield-per-hectare of agricultural crops has an inverse effect upon pheasants. We do not have objective evidence to support this contention but we strongly believe that as cultivation is intensified, cover as well as food is lost to pheasants, and their numbers decline.

The total acreage devoted to grain in 1941 was 10,429 ha, not much below the high reached in 1921 of 10,622 ha. Since 1941 there has been a steady loss of grain acreages, and in 1966 there were 7,820 ha. Market garden acreages dropped by nearly 50% from a 1941 high of 1,769 ha to 971 ha in 1966. Forested land, which is privately-owned and associated with farms, has been steadily declining, particularly since 1951.

Predicted agricultural changes in the Okanagan (detailed in Appendix A) generally appear detrimental to pheasant production: intensive land management will produce higher yields per hectare, a drop in cereal production will occur, and an increase in land devoted to forage crops are forecast. These changes will remove valuable pheasant cover, while weeds and weed seeds will be further reduced. Lowered cereal crop production will cut into available food sources while forage crops do not generally support pheasants. Agriculture in the Boundary will generally decline, and agricultural land will be in part, replaced by housing developments.

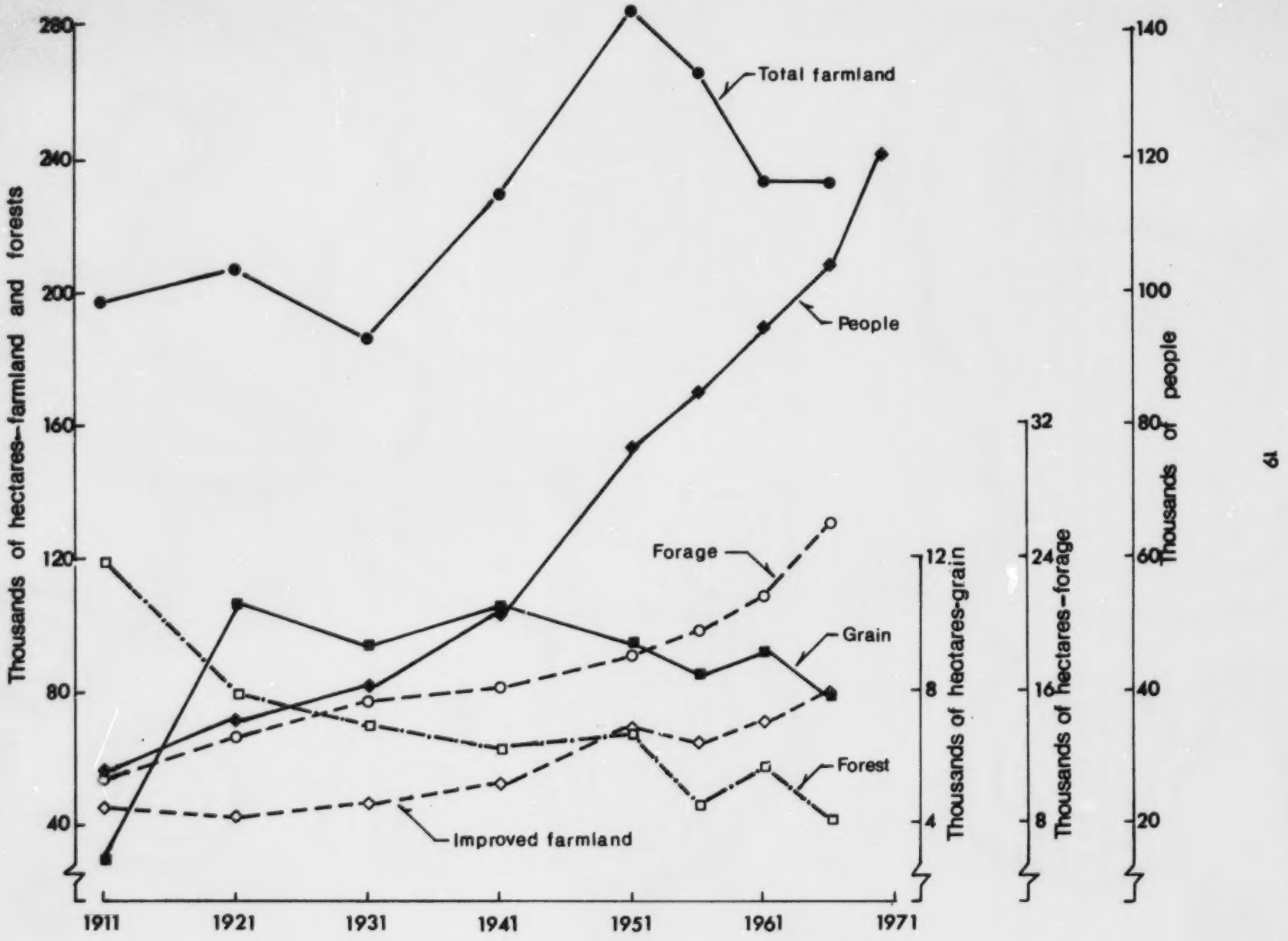

Fig. 2. Major agricultural changes in the Okanagan.

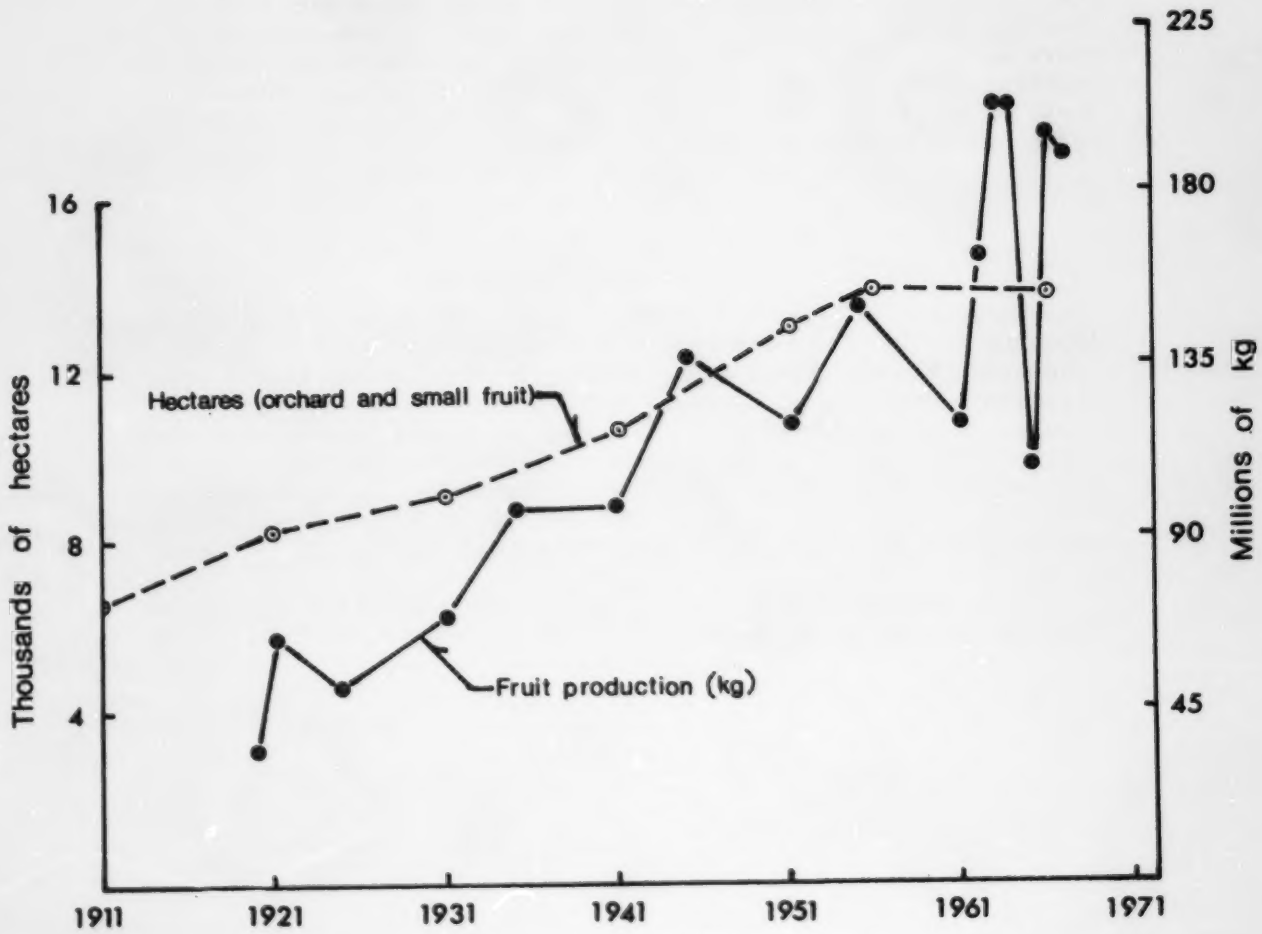

Fig. 3. Orchard area and fruit production, Okanagan Region, 1911–1967.

Mechanization

The farm tractor rapidly replaced the horse as the predominate source of power for cultivation (Anon. 1911-1966). In 1921, at about the time pheasants were beginning to increase, there were only 66 tractors in the Okanagan. By 1941 there were 521 tractors and by 1966 there were 4,375 units. The farm tractor has enabled the farmer to cultivate larger areas, clear rough sections and plough corners. These improvements, made possible through mechanization, inevitably reduce pheasant food and cover.

People

Population growth is shown in Fig. 2 and described in detail in Appendix B. The trend has been one of constant increase: 12,085 people in 1901 had increased to 105,750 in 1966 (Anon. 1969). The estimated population in 1968 was 120,700 and the 1975 projected population is 135,000 people. Although the Region encompasses about 2,851,840 ha, people occupy approximately 293,560 ha (occupied land in this context is privately owned land): 59,800 ha in the Boundary, 92,160 ha in the South Okanagan and 141,600 ha in the North Okanagan. There is now about one person per 3 ha of occupied land.

One projection (Dayton and Knight Ltd., 1969) has placed the Okanagan population at 500,000 in 30 years.

MANAGEMENT INVESTIGATIONS

Prior to the early 1950's pheasant management was largely restricted to the stocking of birds, setting hunting sessions, plus daily and seasonal bag limits. A series of relatively standardized data-gathering programs were initiated in 1950, with the hoped-for goal of explaining and predicting harvest and population changes since that date.

Seasons and bag limits

Seasons for cock pheasants have been in effect since 1913 in some areas, only 3 years after the first successful introduction. We could find no complete record of season bags and dates prior to the 1929-30 season.

Since 1929-30 there has been a confusing array of season dates and bags for the North and South Okanagan, and the Boundary. In general, however, the season has continued for 4-6 weeks, beginning in early or mid-October. The daily bag has varied from two to five birds and the seasonal bag from six to twenty birds. The season bag was discontinued in 1963 and since then the only restriction has been a daily bag of three birds and possession limit of nine birds.

Shooting has been restricted to cocks-only, except for the 1942 and 1968 seasons. The 1942 hen season was opened in a restricted area of the Coldstream district for the purpose of reducing crop damage by pheasants. The 1968 hen season was initiated in Management Area 6 of the Okanagan Region (includes the Okanagan River watershed of the South Okanagan and North Okanagan of Fig. 1) as an experiment to determine hunter's acceptance of such a hunting opportunity. One hen per day was allowed during the last week of the regular season. Interest in shooting hens was low, and the general antipathy to such a season precluded its repetition.

Harvest estimates

The first total harvest estimate, based on a mailed hunter questionnaire, was calculated for the 1949 season when it was estimated that 35,239 cock pheasants were taken from the Central Interior of British Columbia (Table 2). This estimate includes the Okanagan and the Thompson Valley harvest. The bulk of the harvest has come from the Okanagan (78% to 88%, Table 2) during the 7 years for which we have specific data and we assume this has been the pattern throughout other years.

The estimated Interior harvest dropped during 1950 to 9,050 birds, then gradually climbed to 30,362 birds in 1962. Since 1962 the harvest has been decreasing and in 1968 only 9,055 birds were harvested, equal

to the 1950 low. Hunter success figures (birds/hunter) are shown in Table 2 and Fig. 4. Hunter success, in general, follows the harvest trend.

Table 2. Estimated numbers of hunters, harvest and birds per hunter from the the Southern Interior of British Columbia from 1949 to 1970. Okanagan data included when available (From British Columbia Game Harvest Questionnaire Analysis, 1949-1970).

	Hunters		Harvest		Okanagan Harvest as a Percent of Total	Birds/ Hunter
Year	Interior[a]	Okanagan	Interior[a]	Okanagan		
1949	7200		35239			4.9
1950	3350		9050			2.7
1951	9430		12623			3.2
1952	5410		15701			2.9
1953	7990		19975	15458	78	2.5
1954	9020		19370	15718	81	2.2
1955	6230		19901			3.2
1956	6095		17041	14652	86	2.8
1957	6725		16184	14192	88	2.4
1958	7590		26519			3.5
1959	5095		19768			3.3
1960	7368		22104			3.0
1961	7490		27627			3.7
1962	8910		30362			3.4
1963	8110		27572			3.4
1964	8875		26626			3.0
1965	7195		17058			2.3
1966	5329		12788			2.4
1967	4862		12990			2.7
1968	4231	3042	9055	7366	81	2.1
1969	4352	3234	9530	7483	78	2.2
1970	5386	3600	10531	8745	83	2.0

[a] Includes the Okanagan.

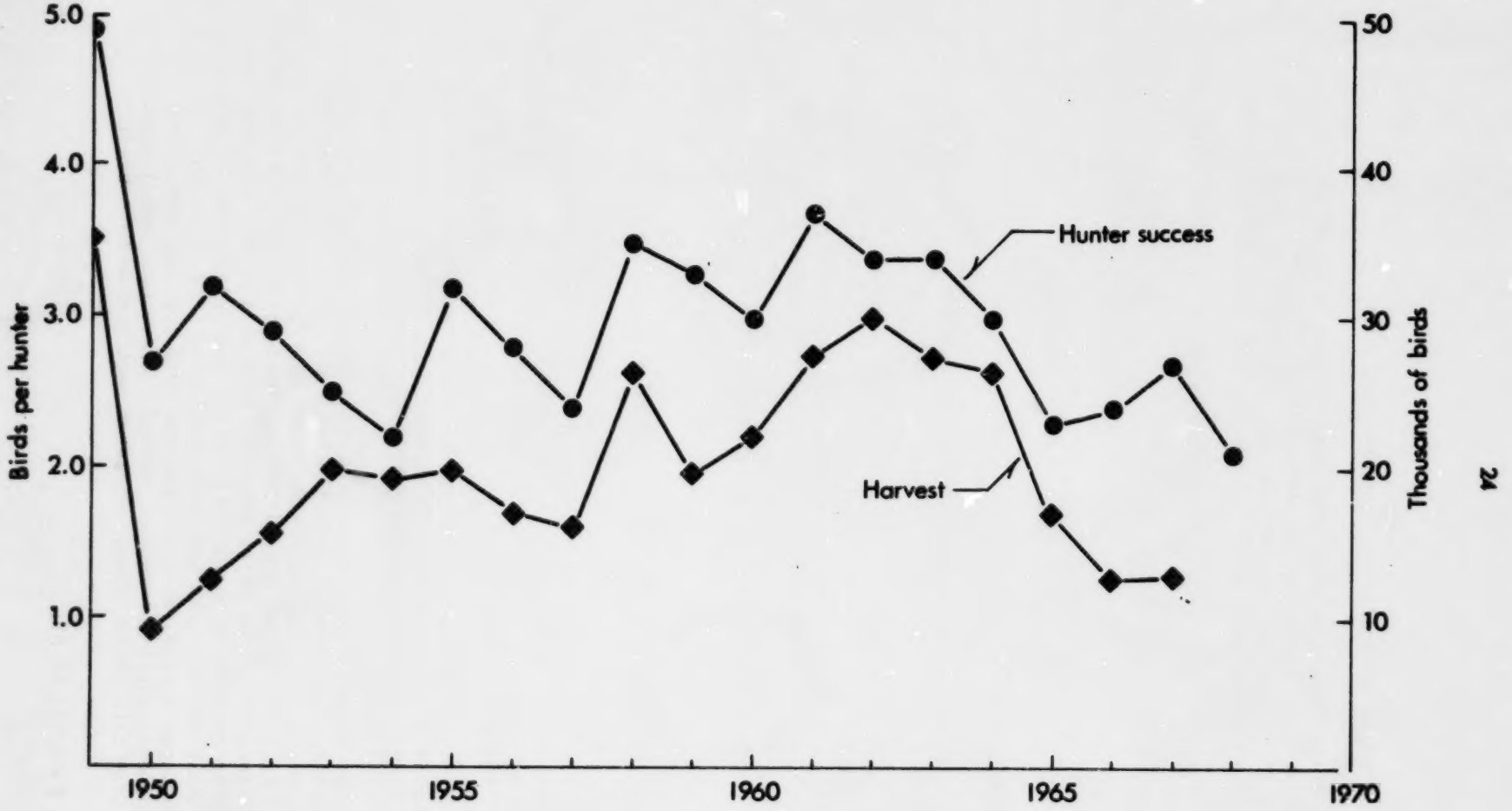

Figure 4. Hunter success and total pheasant harvest for the Southern Interior, 1949 – 1968.

North Okanagan Naturalist's December bird count

The North Okanagan Naturalist Society initiated an annual December bird count in the Vernon area during 1950. We believe the consistency of their counting methods has made their pheasant observations relevant as a general indication of population trends.

Year	1951	1952	1953	1955	1956	1958	1960	1961
Pheasant/Observer:	18	15	14	7	4	28	20	17

Year	1963	1964	1965	1967	1968	1969
Pheasant/Observer:	25	16	7	12	4	5

These counts, when compared with hunter success figures of the previous fall (Fig. 5), show a positive correlation.[a] Fig. 5 does not include those years when the counts were carried out on days with 0 - 5 cm of snow on the ground. During these years (1950, 1954, 1957, 1962) the numbers of pheasants seen seemed low when compared with prior or succeeding years, and showed no correlation with hunter success figures. We have assumed the lack of snow during these "low" years did not concentrate birds adequately to give comparable counts with years when 8 cm or more of snow lay on the ground at the time of the count.

Relationship between hunter success and the population

Any meaningful discussion of the Okanagan pheasants must be based on some measure of population fluctuations. The most consistent series of observations are those connected with the harvest, i.e., total harvest and hunter success. In addition, we had pheasant observations from the Naturalist's December bird count. When these two independent series of observations were compared we found a positive correlation (Fig. 5). In addition, birds checked on the annual road check (data since 1960) show a general decline similar to the declining hunter success as estimated from the mailed questionnaire (Fig. 6).

Wagner et al. (1965) have shown that hunter harvest reflects fall population fluctuations. On the basis of their study, and the observed positive relationship between the bird/hunter figures as calculated from the mailed questionnaire, road check data, and the winter counts carried out by the North Okanagan Naturalists, we have used the annual Hunter Success (birds/hunter) as the best reflection of changing numbers within the Okanagan pheasant population (Fig. 4). The population began a slow recovery from the 1950 low, and showed an erratic increase until the 1960-61 period. There has been a general decline since this latter time. In later sections we have utilized

[a] t-test, $P = 0.01$, 12 df.

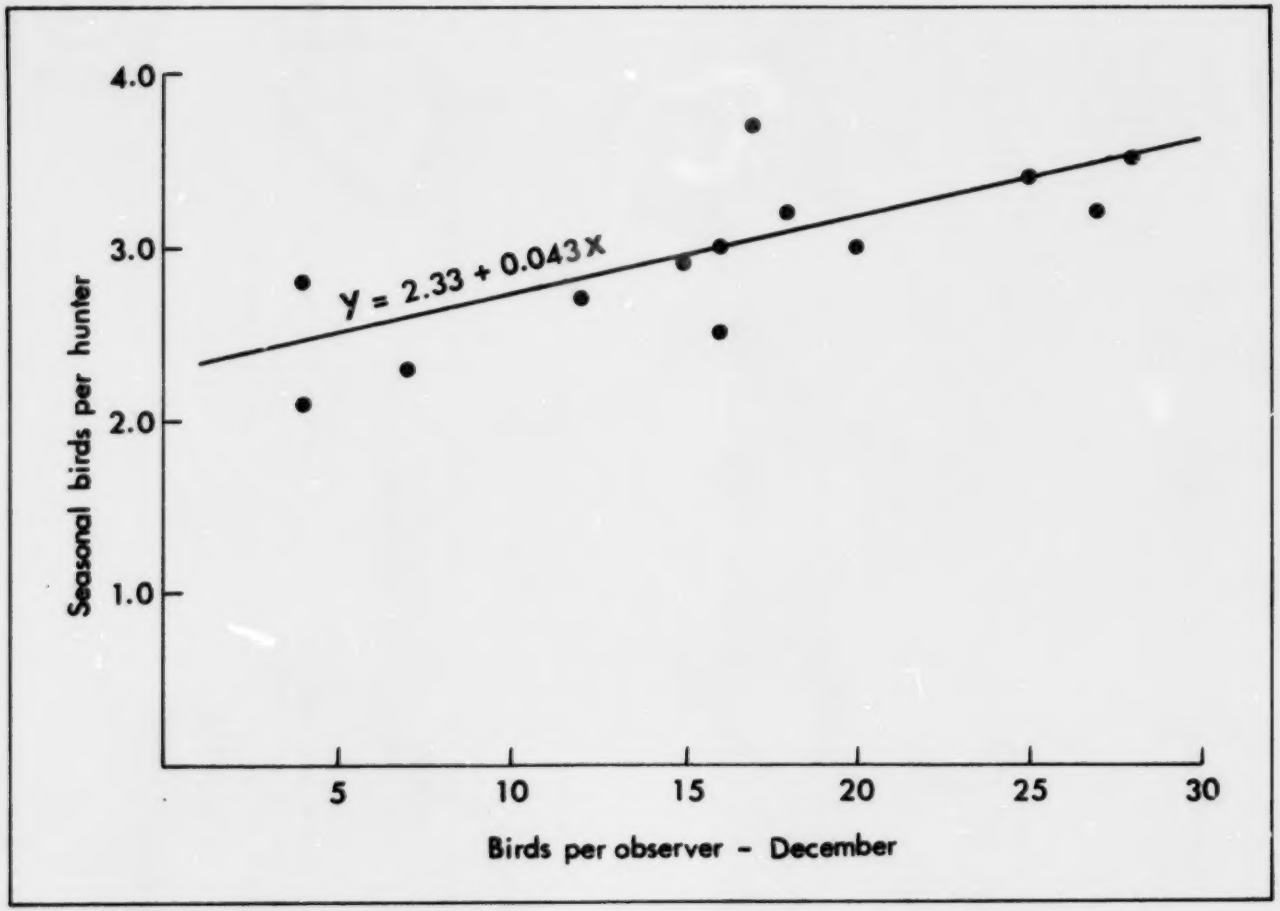

Figure 5. Relationship between seasonal birds per hunter and birds per observer on the December bird count.

these bird/hunter figures as an index of population trends.

January - February counts

Winter counts were carried out primarily to determine post-season sex-ratios, but have also been used to calculate spring hen indices and young-per-hen figures. These data are shown in Appendix F.

Winter sex ratios decline progressively from north to south: Vernon-Armstrong, 1 rooster : 5.7 hens; Kelowna 1 : 5.1; Oliver-Osoyoos, 1 : 3.8; Keremeos-Cawston, 1 : 1.5. Analyzing these figures according to the North Okanagan and South Okanagan areas of Fig. 1 the ratios are: 1 rooster : 5.3 hens in the north and 1 rooster : 2.5 hens in the south. These variations probably result from differential hunting pressures. Hunting pressure in the North Okanagan is high and a greater proportion of roosters are harvested from the population; hunting pressure decreases in the South Okanagan region. A similar effect of variable hunting pressure and resultant changes in sex ratios has been noted by a variety of authors, most recently by Wagner et al. (1965).

We found no relationship between the total October-November harvest and the following January or February sex ratios; harvest changes apparently reflect population changes, rather than the removal of a greater or lesser proportion of roosters from a static population.

Spring crowing counts

These were initiated in the Okanagan during May of 1951 by Biologist Ernie Taylor, in the Oliver-Osoyoos area. Several transects in the North and South Okanagan were counted sporadically until 1964 when an attempt was made to standardize five permanent transects: one near Armstrong, one near Vernon, one in the Kelowna-Rutland area, one in the Oliver-Osoyoos region and one from Keremeos south to the United States border. These data are shown in Appendix G.

An analysis of winter weather and succeeding spring crowing count figures was made but no relationship exists between winter weather and the spring population of adult male pheasants; this spring population fluctuates independently of winter weather.

Table 3. Spring crowing counts and hunter success.

Year	Pheasants heard crowing	No. of stops	Birds/ station	Hunter success (Population Index)
1950				2.7
1951			12.5	3.2
1952			13.3	2.9
1953			11.5	2.5
1955			11.0	3.2
1959			9.8	3.3
1963			7.5	3.4
1964	468	75	6.2	3.0
1965	277	44	6.3	2.3
1966	510	63	8.1	2.4
1967	485	48	10.0	2.7
1968	512	48	10.7	2.1
1969	481	72	6.7	

All spring crowing count figures are combined by year in Table 3. The observed annual fluctuation of pheasants heard each spring does not correspond with the suggested population index. Females form the largest segment of the population and are dominating influence in determining population levels.

One noticeable population change has been shown by these spring surveys (Appendix G): the Oliver-Osoyoos and lower Similkameen spring pheasant population has shown a marked drop from the early 1950's when about 13 crowers per station were recorded; by 1969 we recorded about two birds per station.

Production of young

Table 4 summarizes available information on nesting, eggs per clutch, and early brood size.

Table 4. Egg laying and production of young pheasants in the Okanagan (from Pacific Nest Record Scheme, 1956-68).

Month	Week	Eggs observed/nest	Weekly average eggs/nest	Young observed (newly hatched)	Average young
April	1				
	2				
	3				
	4	18	18		
May	1	17	17		
	2	8	8		
	3	13,12,11,11,11	11	11	11
	4	14	14	(H)[a]	
June	1	10, 18	14	7, 10 (H)[a]	8.5
	2				
	3	9	9		
	4	10, 13	11	10	10
July	1				
	2	7	7		
	3			8	8
	4	2	2		
August	1				
	2			6	6

[a] Indicates eggs hatched, but no record of brood size.

The earliest egg-laying observation was made during the 4th week of April. Egg-laying appears to reach a peak by the 3rd week of May, and then gradually diminishing until the end of July. The limited information available indicates that the earliest nests contain the largest number of eggs. Allowing for an incubation period of 23 days, the peak of the hatch occurs towards the end of the 1st week or at the beginning of the 2nd week of June.

Average size of broods hatched earlier appears, from the limited data in Table 4, larger than later broods. This has also been reported elsewhere (Wagner et al. 1965). They reported that broods hatched earlier in the season are more vigorous and tend to have a greater survival rate than those hatched at a later date, or following re-nesting.

The greater viability of early-hatched broods is not fully understood, but Wagner et al. (1965) have suggested, on the basis of their own and other studies (Kabat et al. 1956) that the physiological condition of the hen is the controlling influence. "From the onset of laying to late summer or early fall her condition declines apparently due to the successive physiological stresses of egg production, incubation and molt. If the hen's physical reserves are declining during the laying period, the quality of the eggs and consequently the hardiness of the chicks could decline as well."

Early August brood counts were first carried out in the North Okanagan in 1964. Four such counts have been made in the Vernon area and two near Kelowna. These data are shown in Table 5. By early August there is an average of 5.4 young/hen (8 - 9 weeks after the peak hatch period of early June).

Table 5. Early August brood counts, North Okanagan, 1964 - 1969.

Year	Adults counted[a]		Young	U/C	Ratio (young/hen)
	Hens	Cocks			
1964	36	11	189		5.3 : 1
1965	29	9	146	5	5.0 : 1
1966	13	1	73		5.6 : 1
1967	23	6	107		4.7 : 1
1969	23		145		6.3 : 1
Average					5.4 : 1

[a] Includes hens without broods.

Hunter road checks

October road checks, conducted on the first two days of the season, have provided information to measure hunting pressure, hunter success, and the ratio of adult birds to young. This information is summarized in Table 6 and Appendix H.

Number of days spent checking each season has been relatively consistent. However, the daily bag of three birds was reduced to two birds during 1960, 1961, 1962 and 1968, which may have lowered opening week-end hunter success during these years although this is not evident in Fig. 6. In addition, during 1960, 1961 and 1962 checks were held only at Osoyoos and Vernon. From 1963 to 1969 road check locations were consistent: four in the Vernon-Armstrong area, one near Kelowna and one at the head of Osoyoos Lake.

(a) Hunter Success. In general, road check hunter success (Table 6) shows a downward trend from the early 1960's, corresponding to the seasonal hunting success calculated from the mailed questionnaire. These two sets of data show a positive correlation and the opening week-end check results give a good indication of the over-all season success.

Birds-per-check-day (Table 6) show a general decline from a high in 1960 (75) to a low (18) in 1968. This trend is similar to other harvest and population trends in the Okanagan (Fig. 6), and is one more indication of a declining pheasant population.

Table 6. Total birds checked, total hunters, check days and birds per check per day, 1960 - 1970.

Year	Total birds checked	Hunters	Check days[a]	Birds/ check day	Hunter success	
					mail	road check
1960	452	615	6	75	3.0	0.73
1961	464	551	8	58	3.7	0.84
1962	310	330	9	34	3.4	0.94
1963	479	625	14	34	3.4	0.77
1964	503	784	16	31	3.0	0.64
1965	518	927	13	40	2.3	0.56
1966	379	740	14	27	2.4	0.51
1967	341	605	14	24	2.7	0.56
1968	250	521	14	18	2.1	0.48
1969	336	541	14	24	2.2	0.62
1970					2.0	

[a] Total check days for all check points.

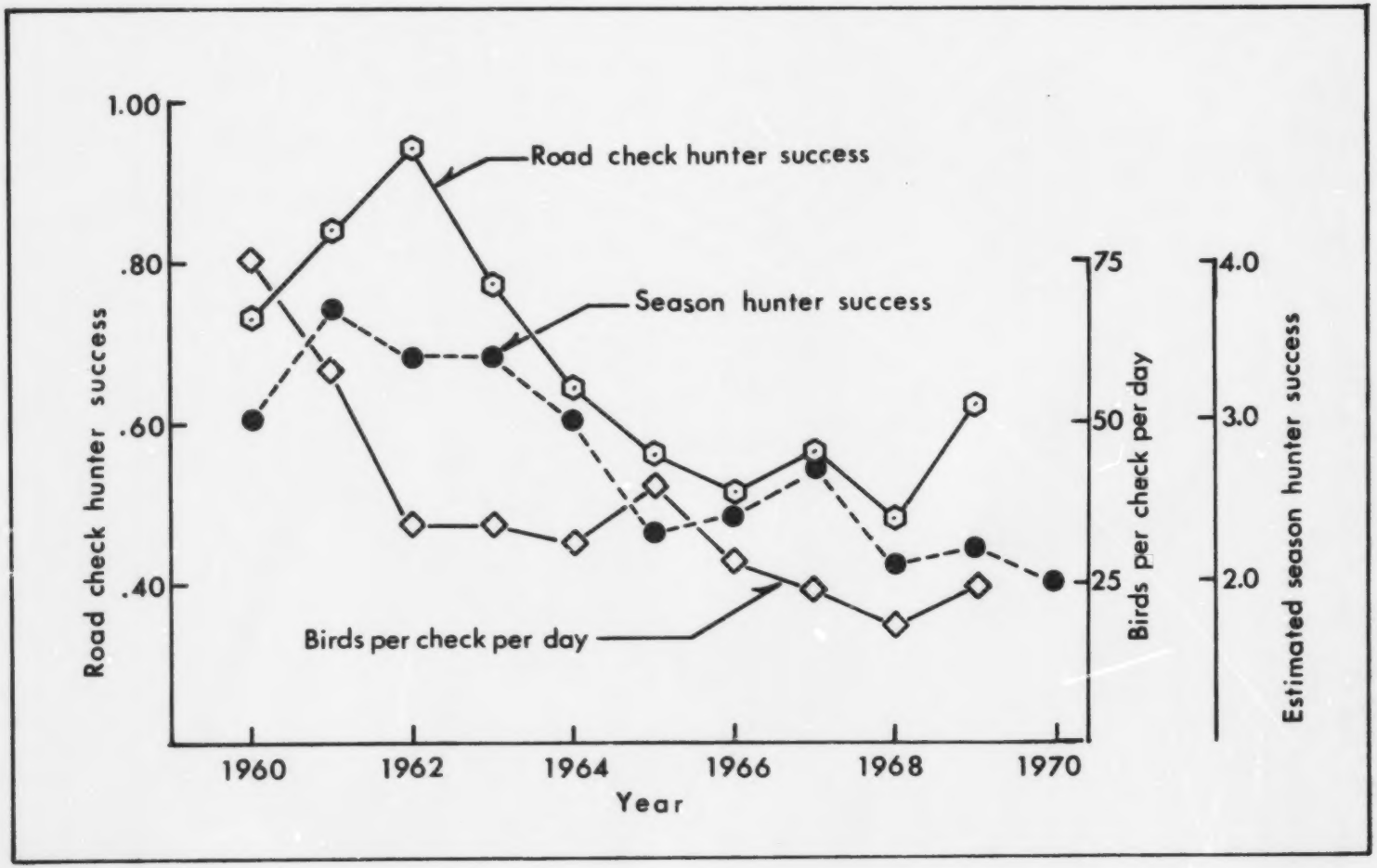

Figure 6. Estimated hunter success from mailed questionnaire, road check hunter success and birds checked per day.

(b) Adult-young ratios. In order to determine the actual young component of the fall population, the adult-young figures collected on the road checks (referring to cocks only) must be interpeted on the basis of the male-female ratio of the population. We have calculated an October young-per-hen figure, with the following formula (Wagner et al. 1965):

$$\frac{\text{number of young cocks/adult cock in the fall harvest}}{\text{number of hens per cock in winter}}$$

These data are shown in Table 7 while the raw data from the winter counts are included in Appendix F. Because the Vernon-Armstrong area of the North Okanagan has been checked consistently and because of observed differences in the age ratios and winter sex ratios from the South Okanagan (Appendix F and H), the Vernon-Armstrong road check and winter count data have been used.

The basis for these calculations is tenuous and conclusions can only be tentative. There is a sampling bias introduced during the fall sampling program as young cocks are shot more readily than adults (Kimball 1948). This will increase the calculated young male per adult male ratio, which will inflate the estimated number of young per adult hen in the fall. Additionally, these calculations assume the fall ratio of adult male and female pheasants is the same as during the preceding winter, and the sex ratio between young males and females is equal during the fall.

Table 7. Young males per adult male (October), hens per cock (winter) and calculated young per hen (fall).

Year	Young/adults (cocks)	Hens/cock (winter)	Young/hen (fall)
1961	6.3	3.8	3.3
1962	4.2	5.5	1.5
1963	5.1	5.2	2.0
1964	5.1	8.4	1.2
1965	4.5	4.2	2.1
1966	5.1	8.1	1.3
1967	-	-	-
1968	5.0	5.5	1.8
1969	3.8	6.4	1.2
Average			1.8

Autumn recruitment appears low in the North Okanagan, although these data were collected during a declining population. The calculated average number of young per adult hen, by early October, is only 1.8, dropping from an average of 5.4 young/hen during early August. Thus, even by early October, assuming an equal sex ratio of young birds, there is only about one female young per adult hen.

The heavy loss of young birds apparently does not take place during the winter but during the summer and early fall, following our early August counts and prior to the early October road checks.

In Appendix C we have further analysed the relationship between (a) the spring hen population and the ensuing population of young birds in the fall, (b) the spring hen population and the number of young per brood in August and (c) the young/hen index as calculated in the fall and the relationship of this figure to annual population changes. Data for these calculations are questionable and conclusions can only be very tentative.

CLIMATE AND PHEASANT POPULATIONS

Several North American studies have had mixed success in their attempts to correlate pheasant population changes with weather. Lumby (quoted in Kimball 1948) said, "Together or single, no conclusions could I draw from the charts" whereas Wagner et al. (1965) suggested that a general pre-nesting temperature decline caused the pheasant population decline throughout the Midwest States in the early 1940's. Stokes (1968) concluded that mean spring temperatures (April 20 - May 10) in Utah may have influenced productivity.

In our analysis of winter weather, pre-nesting temperatures and precipitation (April and May), post-hatching temperatures, and precipitation (June), we could find no single weather component which appeared to influence the population. However, by combining an index which represented winter severity[a] with the mean daily temperature during June, we arrived at a General Weather Index (Appendix I) which, when compared with the percent population change index "x", showed promise. These figures are tabulated in Table 8 and illustrated in Fig. 7 for the years 1950 - 1961. The population was increasing during this time and this increase seems associated with the General Weather Index.[b] Mild winters and warm Junes were correlated with a population increase. Since 1961, while the population has been declining, there has been no correlation, even when mild winters and warm Junes combined to create favourable weather conditions. It is probable that since 1961 habitat changes have over-ridden weather as the primary influence upon this population.

[a] This index was calculated by subtracting the figure representing total January snowfall (inches) from the figures representing mean minimum January temperature (°F). This report was initially written before the metric system became standard for Fish and Wildlife Reports. The General Weather Index was based on the British system and could not be conveniently converted to metric.

[b] t-test, $P = 0.05$, 10 df.

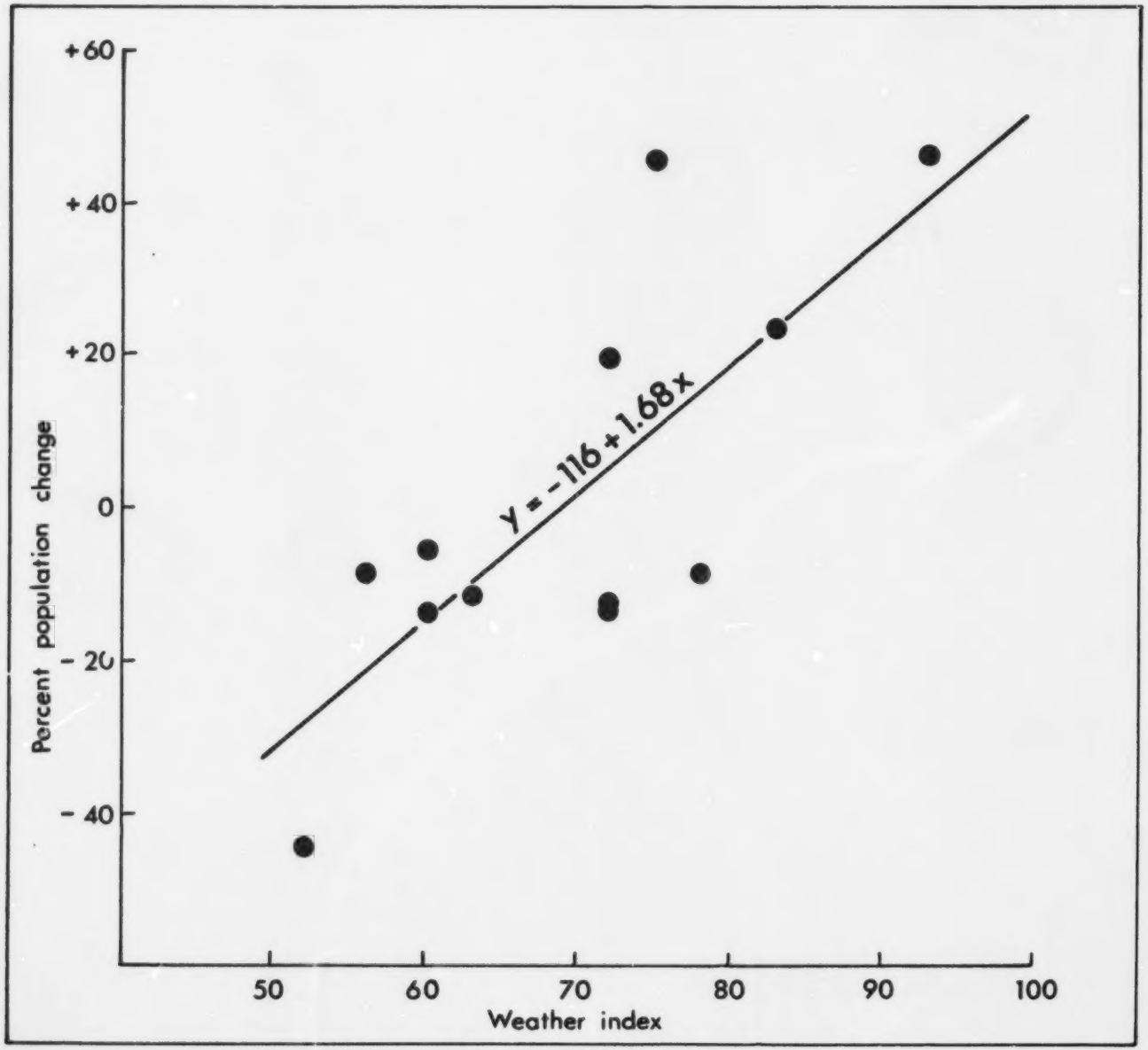

Figure 7. Relationship between percent population change x and the general weather index.

Table 8. General Weather Index and percent pheasant population change, 1950 to 1961.

Year	General Weather Index	Percent population change
1950	52.4	-45
1951	71.7	+19
1952	56.2	- 9
1953	72.5	-14
1954	62.9	-12
1955	75.4	+45
1956	72.1	-13
1957	59.6	-14
1958	93.0	+46
1959	59.7	- 6
1960	77.8	- 9
1961	83.4	+23

The role of weather during the years of major population build-up and decline (late 1930's to the late 1940's) was also examined (Figure 8). Although our pheasant population data are fragmentary the probable peak years from 1938 to 1946 were associated with a prolonged period of relatively mild Januarys and Junes. During the 11-year period, 1938-1948, 10 of the winters and springs favoured the pheasants.

The following decade was uniformly unfavourable - winter and spring of each year were generally colder with greater precipitation than normal.

However, our admittedly fragmentary information indicates that the population began to drop during 1947, a "good" year, and continued through 1948, another "good" year, to 1949 and 1950, both severe winters and springs.

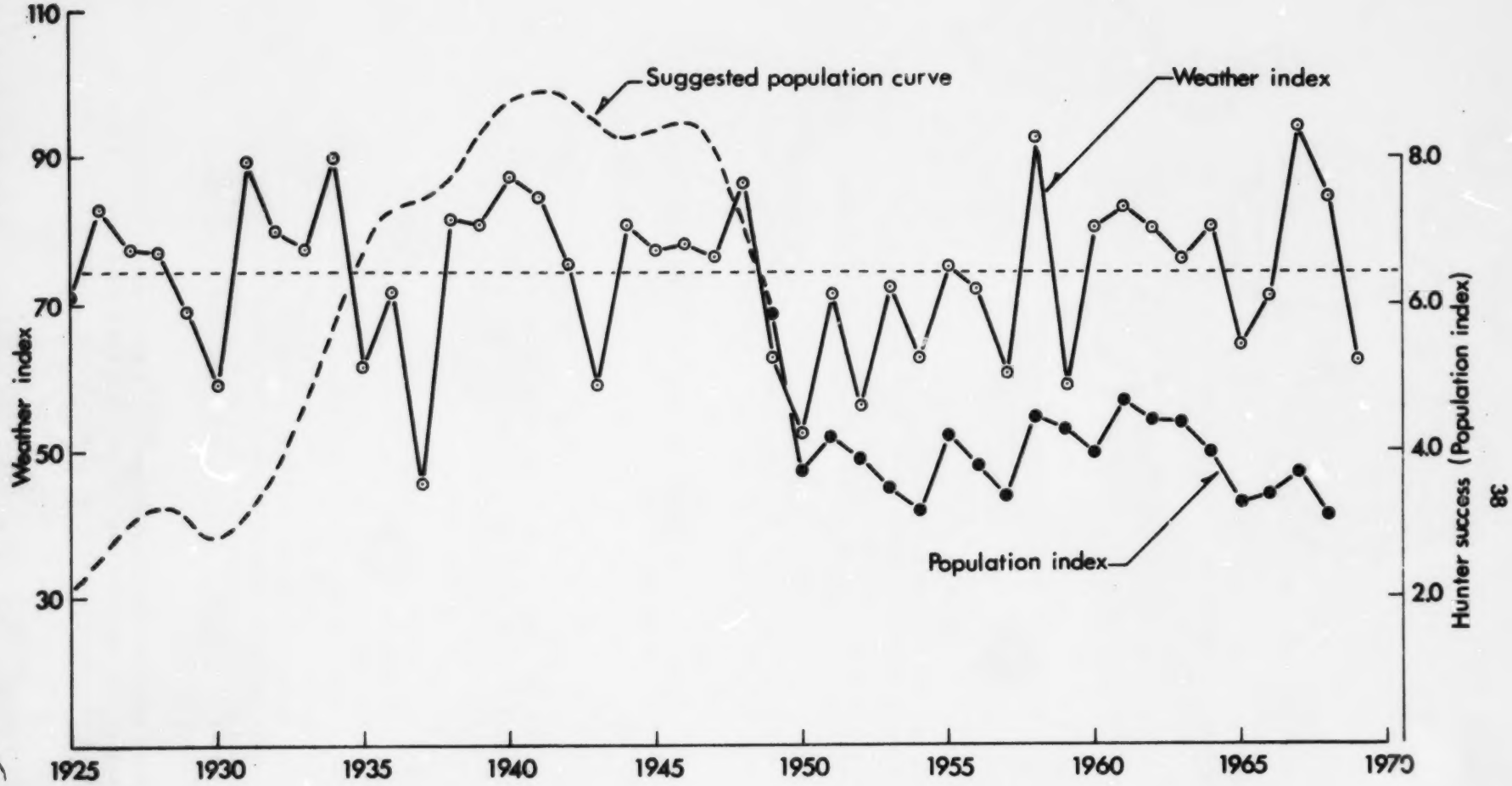

Figure 8. Suggested population curve, population index since 1949 and general weather index.

DISCUSSION

The Okanagan pheasant population has followed the pattern of most pheasant populations throughout North America. After successful introductions during the first decades of the 20th century, there was a rapid build-up of birds during the late 1920's and the 1930's. The environment was ideal for these birds of Asian origin - a warm, dry climate combined with an expanding agricultural base. We have suggested the winter-spring weather patterns during the years 1938-47 (mild winters and warm springs) facilitated the population "explosion."

The rapid population decline of the 1947-50 period is still largely inexplicable. Studies following the decline suggested that none of the following, taken by themselves, could have caused the loss of birds: hunting, pesticides, disease, predation, population cycles and the retrenchment of an introduced species. Although weather was discounted at the time, winter and spring weather conditions during 1949 and 1950 may have depressed the population. However, if our population curve is correct (Fig. 8), the winter-spring weather of 1947 and 1948 did not initiate the population drop. Lack of accurate population estimates during the 1940's rule out any definitive answers.

We believe the population underwent a slow and erratic increase until the 1960-61 period. This increase took place despite below-average weather conditions (Fig. 8) and an increasingly hazardous and shrinking habitat.

The upper limit of this second population increase (1960-61) was probably set by the reduced capacity of agricultural and wild land in the valley bottoms to support pheasants.

We believe the decline, from 1962 to the present, reflects a further loss of pheasant habitat. Although we are unable to prove the suggested relationship between the declining pheasant population, changing agricultural practices and an increasing human population, we believe the circumstantial evidence points to these negative influences.

The land base (total agricultural land) reached a peak as the pheasants began to recover from the major population decline of the late 1940's. Total acreages devoted to agriculture began to drop following 1951. Grain acreages decreased, as well as forested land. This latter category includes the forested areas associated with farms and provides an important source of cover and food along the field edges. Vegetable gardens, always an important food source for pheasants throughout the 1940's, declined from a peak of about 1,800 ha to 960 ha in 1966. Increases in hay and forage production resulted in further habitat losses.

Orchards have provided an increasingly hazardous environment for the pheasant. McTaggart-Cowan (1942) observed that cover, food and water were in good supply in orchard communities. Benson (1950) and

Rye (1952) both reported that orchards were of reduced importance as pheasant habitat. We have shown (Fig. 3) that fruit production is increasing at a greater rate than orchard acreages, indicating increased utilization and production-per-hectare. Sprinkler irrigation introduced in 1945, pesticide sprays initiated in 1947, mowing, ploughing, discing, herbicide spraying of small cover areas where the mower cannot reach, and increased mechanization have removed the 14,000 ha of orchard from any effective pheasant production.

The activities of a rapidly increasing human population, which increased from 28,000 people when the pheasant was first introduced to 120,700 people in 1968, have removed much of the habitat previously available for pheasants.

Early brood sizes in the Okanagan are comparable to most other newly hatched broods throughout North America - about 10 chicks per hen. However, by the early part of August, when the young are 8 - 9 weeks old, the Okanagan brood survival of 5.4 young per hen is lower than that reported by other authors: summarizing Stokes' (1954) data, which includes a literature summary and his own work, the average survival of young at 8 - 10 weeks of age is 6.4 per hen. Survival of young in Wisconsin is about 7.5 per hen at 8 - 9 weeks of age (Wagner et al. 1965).

The rate of loss of young in the Okanagan apparently increases between early August and early October. At this latter time the young segment of the population has dropped to an average of only 1.8 per adult hen. This loss may be real, or an artifact. If an artifact, it can be explained by the failure of a high proportion of over-wintering hens to bring off broods. Linder et al. (1960) found that "----the primary factor responsible for variations in the rate of production of chicks was the percent of hens bringing off broods and not variation in clutch size and fertility and hatch-ability of eggs". If the percentage of hens bringing off broods in the Okanagan is low and if hens without broods are secretive or do not inhabit the same areas as hens with broods (and are therefore not countable during early August) our calculated losses between August and October are erroneous.

However, if the observed decrease from 5.4 young-per-hen in early August to 1.8 young-per-hen in early October is real we have identified one of the critical periods in the life of young pheasants in the Okanagan. This observation agrees with Wagner et al. (1965), who concluded that there generally tended to be a heavy loss of birds during the late summer and early fall.

Unfortunately, we have no objective evidence to indicate how such proposed late summer-early fall losses are achieved.

The influence of winter and spring precipitation and temperature can be seen in the second build-up of pheasants from 1951-61. Mild Januarys with a relatively low snowfall combined with warm Junes encouraged greater population increases (Fig. 8) than years of cold Januarys and Junes. Pheasants in the Okanagan, at the north-west limit of their North American distribution, are probably more susceptible to

the vagaries of winter and spring weather fluctuations than in some areas where these birds have been studied.

THE FUTURE OF THE PHEASANT IN THE OKANAGAN

"One must wait until evening", Sophocles said, "to see how beautiful the day was." The pheasant "day" in the Okanagan was the decade from about 1938 to 1947. Since that time, and particularly since 1962, a general population decline has taken place and, we believe, will continue. The available habitat, restricted generally to the bottoms of narrow valleys, is too attractive to people and their varied activities for us to look hopefully upon the pheasant's future prospects.

The inevitable environmental changes will not eliminate the pheasant from the Okanagan fauna. Restricted, and ever-shrinking areas of food, cover and water will remain, and there will be pheasant hunting for many years to come. It must be accepted, however, that the Okanagan cannot be regarded as the mecca it once was for the pheasant hunter.

Despite the inevitability of continued habitat degredation, we do not believe the pheasant should be ignored, or that all management programs should be cancelled. Habitat is the key to survival and there are certain aspects of habitat improvement which should be examined. The South Okanagan and the Boundary are largely lost for any major habitat improvements. These two sub-areas still provide about 42% of the land where pheasants are found, but only 21% of the areas of "heavy" concentration. People and orchards in the South Okanagan, and a lack of suitable agriculture in the Boundary, generally preclude any active pheasant management programs in these areas.

However, the North Okanagan holds promise for future work. The first active habitat improvement project was undertaken by a special committee of the Vernon Fish Game and Forest Protective Association in 1957, and was known as Pheasants Unlimited. Patches of food and cover were planted around the Vernon area, several liberations of birds took place, and an attempt was made to introduce a new pheasant strain into the North Okanagan. This committee was active until the early 1960's.

In 1967 the Fish and Wildlife Branch acquired 26 ha of land north of Vernon. Our hoped-for development program, in conjunction with the Vernon and District Fish and Game Club, is to experiment with, and establish, a variety of food and cover types suitable for the North Okanagan. We hope to provide farmers and other land-owners with some guide-lines for the improvement of small parcels of their land for the pheasant. If small pheasant populations can be encouraged and maintained on these lands, the land-owners may be able to realize a secondary income from hunters.

LITERATURE CITED

Anonymous. 1911-1916. Census of Canada Agriculture: British Columbia. Dominion Bureau of Statistics, Ottawa, Ontario.

Anonymous. 1920-1967. Production of tree fruit crops with an estimate of farm values. Horticultural Br. Brit. Col. Dep. Agric., Victoria, B.C.

Anonymous. 1925-1969. Monthly Record of Meteorological Observations in Canada. Meteorological Br. Canada Dep. Transport, Ottawa, Canada.

Anonymous. 1946. Provincial Game Commission Report. Dep. Attorney-General, Victoria, B.C.

Anonymous. 1950. Report of the Provincial Game Commission. Dep. Attorney-General, Victoria, B.C.

Anonymous. 1965. The Grand Forks-Greenwood Region: An Economic Survey. Bureau of Economic and Statistics, Victoria, B.C.

Anonymous. 1966, 1967, 1968. Agricultural Outlook Conference. Brit. Col. Dep. Agric., Victoria, B.C.

Anonymous. 1967. The Okanagan Bulletin Area. Bull. Area No. 2. Dep. Lands and Forests, Victoria, B.C. 94pp.

Anonymous. 1969. Population Changes, Census Division 2. Economics and Statistics Br. Dep. Industrial Development, Trade and Commerce, Victoria, B.C. 1pp.

Anderson, E.M. 1913. Provincial Museum Report, Victoria, B.C.

Benson, W.A. 1950. The effect of orchard spraying on pheasants in the Okanagan Valley, with observations of the bird life in orchard areas. M.A. Thesis. Univ. British Columbia, Vancouver. 90pp.

Butler, H.T. 1963. A report on the ringneck pheasant population of the District Municipality of Salmon Arm and the Salmon River Valley. Fish and Wildl. Br., Victoria, B.C. 14pp., mimeo.

Carl, G.C., and C.J. Guiguet. 1958. Alien animals in British Columbia. Handb. No. 14. Brit. Col. Prov. Mus., Victoria, B.C. 94pp.

Dayton and Knight Ltd. 1969. City of Penticton Water Quality Control. Dayton and Knight Ltd. Consulting Engineers, Vancouver, B.C. 67pp.

Fowle, C.D. 1944. An analysis of game damage problems in the Duncan area on Vancouver Island. Brit. Col. Game Comm. and Dep. Zool. Univ. of Brit. Col., Victoria. 54pp, mimeo.

Kabat, C., D.R. Thompson, and F.M. Kozlik. 1950. Pheasant weights and wing molt in relation to reproduction with survival implications. Wisconsin Cons. Dep. Tech. Wildl. Bull. 2. 26pp.

Kabat, C., R.K. Meyer, K.G. Flakas, and R.L. Hine. 1956. Seasonal variation in stress resistance and survival in the hen pheasant. Wisconsin Cons. Dep. Tech. Wildl. Bull. 13. 48pp.

Kimball, J.W. 1948. Pheasant population characteristics and trends in the Dakotas. Trans. North Am. Wildl. Conf. 13:291-314.

Krajina, V.J. (ed.) 1965. Ecology of North America, Volume 1. Dep. Botany, Univ. British Columbia, Vancouver.

Linder, R.L., D.L. Lyon, and C.P. Agee. 1960. An analysis of pheasant nesting in south-central Nebraska. Trans. North Am. Wildl. Conf. 25:214-304.

Mallette, R.D., and H.T. Harper. 1964. Population studies of ring-necked pheasants in California. Calif. Fish and Game 50(4):292-304.

McTaggart-Cowan, I. 1942. Economic status of the pheasant on the cultivated lands of the Okanagan Valley, British Columbia. Pages 49-62 in Rep. on the Provincial Game Comm. for the year ending December 31, 1942. Dep. Attorney-General, Victoria, B.C.

McPhee, E.D. 1958. The Report of the Royal Commission on the Tree Fruit Industry of British Columbia. Brit. Col. Dep. Agric., Victoria, B.C. 810 pp.

Morton, W.F., and K.E. May. 1966. Second Approximation Report, South Okanagan Area. Brit. Col. Dep. Agric., Victoria, B.C. 60pp.

Oswell, M.G., and G.D. Johnson. 1966. North Okanagan Region Second Approximation Report. Brit. Col. Dep. Agric., Victoria, B.C. 75pp.

Petrides, G.E. 1954. Estimating the percentage kill in ring-necked pheasants and other game species. J. Wildl. Manage. 18(3):294-297.

Robertson, W.B. Jr. 1958. Investigations of ring-necked pheasants in Illinois. Illinois Dep. Cons. Tech. Bull. 1. Springfield. 138pp.

Rye, D. 1952. Factors affecting orchard pheasant populations in the Okanagan Valley of British Columbia, with special reference to orchard insecticides. M.A. Thesis. Univ. British Columbia, Vancouver. 67pp.

Spalding, D.J. 1966. Are the pheasants a plague? Wildl. Rev. 3(10):4-7.

Stokes, A.W. 1954. Population studies of the ring-necked pheasant on Pelee Island, Ontario. Ontario Dep. Lands and Forests Wildl. Ser. 4. 154pp.

Stokes, A.W. 1968. An eight-year study of a northern Utah pheasant population. J. Wildl. Manage. 32(4):867-864.

Taylor, E. 1962. Notes on pheasants in British Columbia. Fish and Wildl. Br., Victoria, B.C. 9pp., mimeo.

van Nostrand, N. 1963. Pheasant populations in Nova Scotia. Nova Scotia Dep. Lands and Forests. 23pp., mimeo.

Wagner, H.W. 1957. Late summer mortality in the pheasant hen. Trans. North Am. Wildl. Conf. 22:301-315.

Wagner, H.W., C.D. Besadny, and C. Kabat. 1965. Population ecology and management of Wisconsin pheasants. Wisconsin Cons. Dep. Tech. Wildl. Bull. 34. 167pp.

Wagner, H.W., and A.W. Stokes. 1968. Indices to overwinter survival and productivity with implications for population regulation in pheasants. J. Wildl. Manage. 32(1):32-35.

Westerskov, K. 1955. The pheasant in New Zealand. New Zealand Dep. Internal Affairs Wildl. Pub. 40. 35pp.

Williams, A.B. 1905, 1910, 1911, 1914, 1915, 1918, 1924. Game Warden's Rep., Province of British Columbia, Victoria, B.C.

APPENDIX A

Predicted changes in agriculture

APPENDIX A

Predicted changes in agriculture

General

The predictions are partially based on projections from the previous ten-year period and, where possible, on foreseeable changes in land use and farm practices. The data has been compiled from the following sources: Agricultural Outlook Conferences (Anon., 1966, 1967 and 1968); Oswell and Johnson (1966); Morton and May (1966); and Anon. (1965).

North Okanagan

Agriculture in the North Okanagan is predicted to increase slightly and to remain an important segment of the economy. The increases, however, are expected to be due to an increase in production per acre and not as a result of new land being brought into cultivation. The exception to this is forage crop production. Land clearing is expected to continue at the present rate of 600 ha per year with most of it going to forage production. On the other hand, acreages devoted to cereal grains will probably decrease as dry land farming gives way to irrigated crops.

Tree fruit acreages are expected to decrease slightly but the number of trees, particularly apple, will increase as the standard trees are replaced by higher density dwarf stocks. Urbanization will probably reduce the total orchard acreage although this is not expected to be significant within the next 10 to 15 years.

Small fruit and grape production will increase to supply the local demand. The acreages involved, however, are comparatively small.

Vegetable acreages are predicted to increase from 1,447 ha in 1966 to 2,000 ha in 1985. This figure is based on the predicted demand, and on present and potential land available. However, it could be much higher if proposed irrigation projects are implemented.

South Okanagan

On the surface it appears there will be room for expansion of production of agricultural commodities in the South Okanagan, but there is the danger that urban sprawl could limit this expansion.

Tree fruit acreages are expected to remain stable or to decline slightly. Apple production, however, is expected to increase due to

high-density plantings and to replacement of peach and apricot trees with apple trees.

Grape production should increase markedly in the next 10 - 20 years. It is expected that by 1975, 2 000 ha will be needed to supply the growing demand.

No change is foreseen in the vegetable industry. Production will be primarily geared to the local market.

Hay and forage production is expected to increase. This increase, however, is directly related to the expansion of irrigated acreage.

Boundary

Agriculture in the Boundary area will probably continue to decline. Urban sprawl is expected to encroach on much of the better farm land. Improvements in farming methods and irrigation systems however, could result in substantial production increases.

APPENDIX B

Human population changes

APPENDIX B

Boundary

In the late 1800's prospectors, spurred on by earlier finds of gold, settled in the Boundary area. By the turn of the century hard-rock mining flourished and supported three smelters. The population of the area was closely dependent on mining activities and there was an exodus from the region when the smelters closed in 1918 and 1919. The economic depression continued until 1931.

The total population of the area increased between 1931 and 1941 (TableB-1). While the City of Grand Forks remained stable, Greenwood increased by 200 during this ten-year period. The farm population, however, decreased slightly over the same period.

The next ten-year period, 1941 to 1951, witnessed the second population 'boom'. The total population increased by more than 1,500 as both the city and farm segments increased.

The population has continued to increase since 1957 but this has been due to an increase in the number of urban dwellers. The farm population has decreased steadily from the high level reached in 1951.

Table B-1. Population changes in the Boundary and North and South Okanagan Districts.

District	1901	1911	1921	1931	1941	1951	1956	1961	1966
Boundary	- [a]	-	5797	4806	5459	7078	7432	8111	
Okanagan	-	-	29725	35717	46146	70608	77439	86535	
Total	12085	28066	35522	40523	51605	77686	84871	94646	105759
Farm Population									
North Okanagan	-	-	-	9919	10728	14946	15671	11723	
South Okanagan	-	-	-	2991	3784	5643	5999	5040	
Boundary	-	-	-	2094	1961	2507	1997	1063	
Total	-	-	-	16340	17251	23998	24155	17993	18523

[a] Not available.

North and South Okanagan

The Okanagan region has experienced a continuous population growth (Table B-1). Prior to 1900 permanent settlements were limited to scattered ranching communities. The Okanagan 'land boom', from 1900 to 1910, flooded the area with immigrants. The total population (including the Boundary District) increased by 132%. The City of Vernon experienced a 233% increase during the 'boom' years.

Following the collapse of the 'land boom' and the start of World War I, the rate of population growth slowed. Between 1911 and 1921 the total population (including the Boundary District) increased by only 27%. The cities continued to grow and by 1921 the three main centers, Kelowna, Vernon and Penticton, boasted populations of 2,520, 3,685 and 3,979 respectively. In addition, many small farming communities, such as Armstrong, Enderby, Coldstream and Peachland, had been established by 1921.

The Okanagan area population increased by only 6,000 people (20%) between 1921 and 1931. The three main urban centers, Penticton, Kelowna and Vernon, absorbed half of this increase. The farming communities, however, showed either a very slight increase or a decrease over this decade.

There was a steady influx of people during the 1930's. Of the 10,400 population increase, 1,600 joined the farm population and 2,900 settled in the three main urban centers. The small farming communities again remained stable. The remaining 6,000 people were added to the unorganized rural communities. A large percentage of these were adjacent to the main urban centers.

A second population 'boom' hit the area immediately following the Second World War. The farm population accounted for 25% of the total increase of 24,500 people between 1941 and 1951. The three main cities continued to expand and absorbed 44% of the total increase. The City of Penticton, with a population of 10,548 was the largest in the Valley by 1951. In addition, two cities in the South Okanagan, Oliver and Osoyoos, were incorporated during this decade.

All segments of the population continued to increase to the mid-1950's. This was partially enhanced by the opening of the Hope-Princeton Highway in 1949. This connection to the densely populated coast increased interest in the Valley as a tourist attraction, and resulted in a continued growth of all urban centers.

The farm population reached a peak in 1956 and then declined sharply to 1961. The total population, however, increased by 9,000 over the 5-year period. The City of Kelowna attracted 4,000 of these newcomers and by 1966 was the largest city in the Valley.

In the last 10 years the tourist industry in the Valley has expanded rapidly. This has resulted in large population concentrations which, in turn, have spurred the development of secondary industries. It is conceivable, therefore, that agriculture will decline in

importance, hence, the farm population will continue to decrease.

APPENDIX C

Pheasant population changes and some possible influences upon the population

APPENDIX C

(a) Spring hen population and number of chicks per brood in August.

The spring hen index (an index of the spring hen population) has been estimated from the following formula;

mean numbers of crowing birds/station X male: female ratio observed during winter counts (Wagner et al. 1965).

These data have not been graphed (as there are only 4 observations) but there is a suggestion that a high spring hen population produces a high number of young per hen during August (Table C-1).

Table C-1. Average number of spring crowers per station, winter sex ratios, calculated hen population index and observed young per hen in August.

Year	Spring crowing counts	Winter sex ratios (female : 1 male)	Hen index	Young/hen
1961		3.8		
1962		5.5		
1963	7.5	5.2	39.0	
1964	8.1	8.4	68.0	5.3
1965	5.6	4.2	23.5	5.0
1966	7.3	8.1	59.1	5.6
1967	11.4			
1968	11.2	5.5	61.6	
1969	10.2	6.4	65.3	6.3

(b) Spring hen population and number of young per hen in the fall.

A regression of the spring hen index upon the fall young per hen data is shown in Fig. 1. These figures suggest an inverse relationship: a high spring hen population results in a relatively low number of young per hen in the early fall. As in (a) above, no statistical testing of these data is warranted as we have too few sets of figures, although a trend is indicated.

(c) Number of young per hen in the fall and percent population changes.

A population change index has been estimated by calculating the percent change in hunter success from one fall to the next which, in turn, represents the percent change in the fall population. The symbol "x" has been used in this context as a measure of the percent rate of increase or decrease of the population ("x" is equivalent to "r" in Wagner et al. 1965, but we have not used the symbol "r" as this usually refers to the estimated correlation coefficient). These data are shown in Table C-2 and Fig. 2.

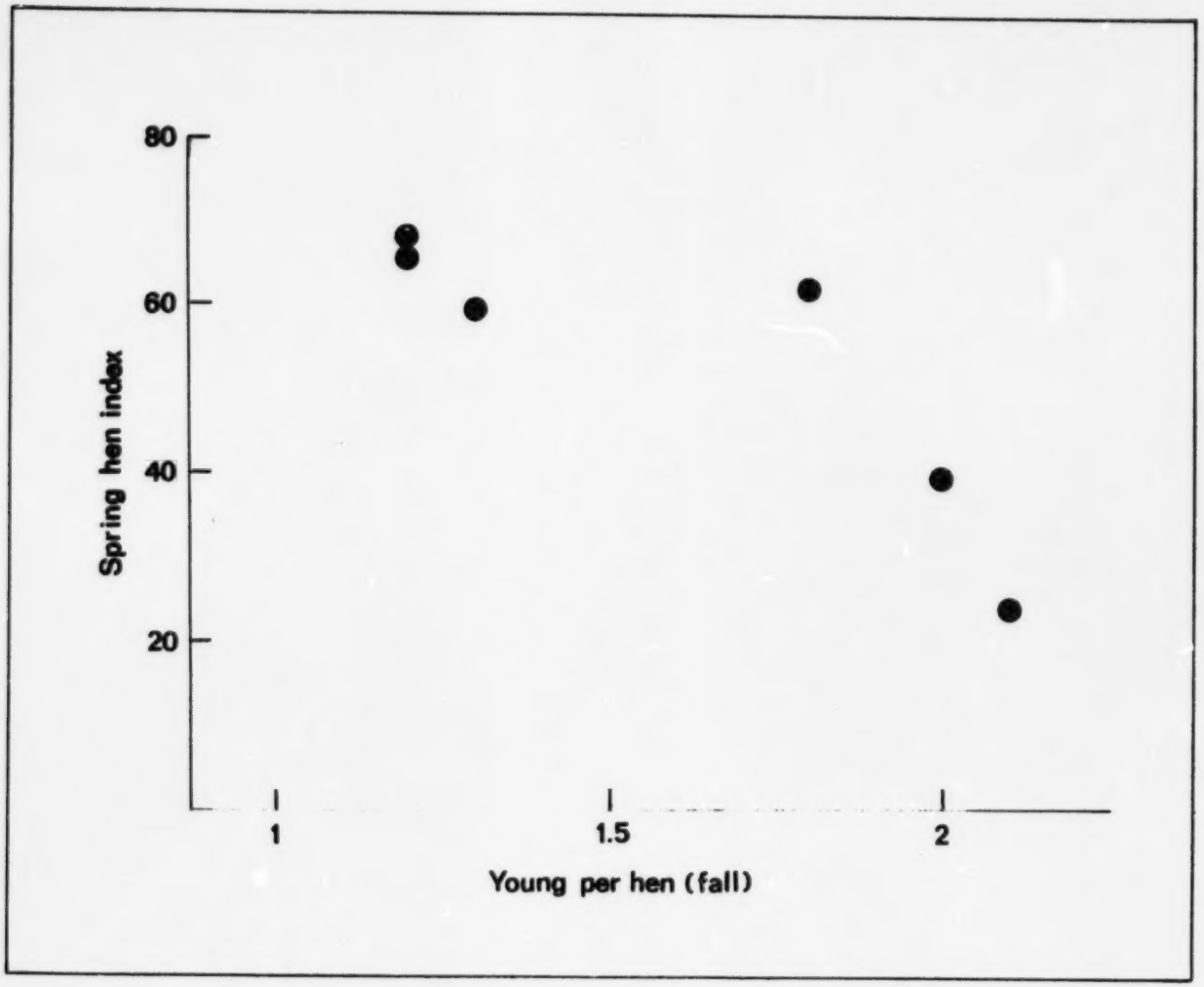

Figure 1. Relationship between spring hen population and October young bird per adult hen (North Okanagan data).

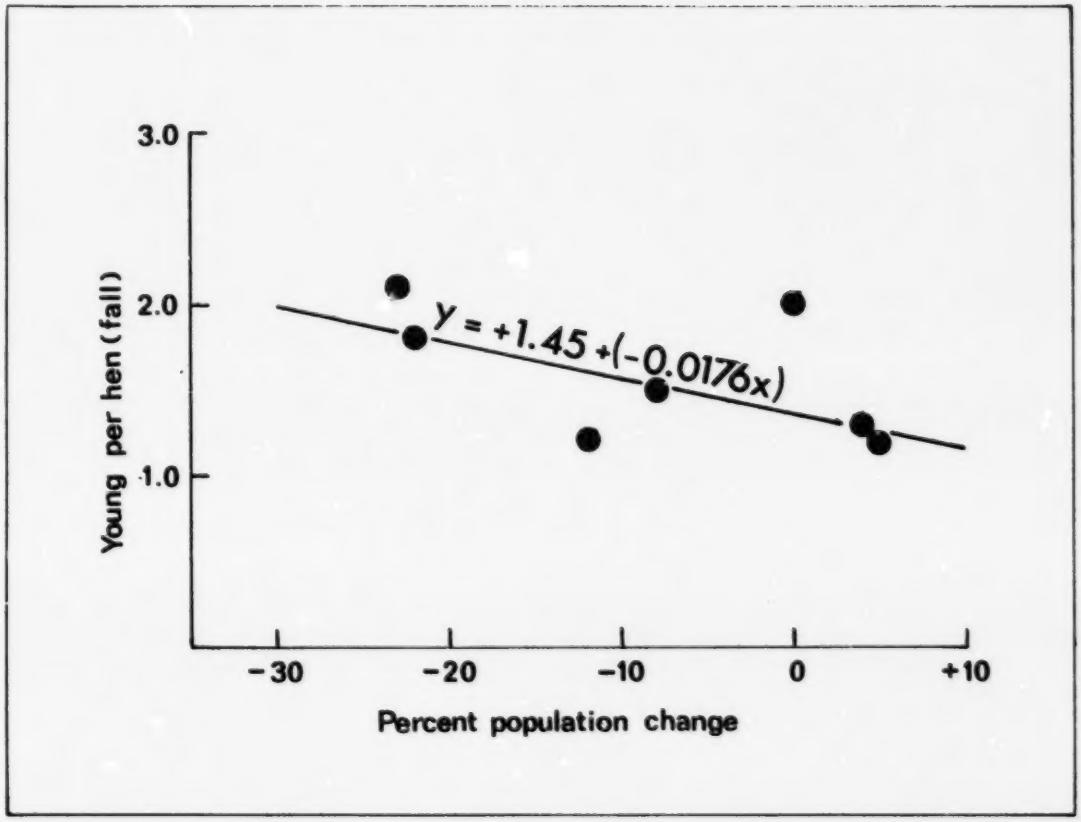

Figure 2. Relationship between young per hen in the fall and percent population change (Vernon and Armstrong data).

Table C-2. Birds per hunter estimated from mailed questionnaire, young/hen (fall) and percent population change.

Year	Birds/hunter	Young per hen (fall)	Percent change from previous year[a]
1962	3.4	1.5	- 8
1963	3.4	2.0	0
1964	3.0	1.2	-12
1965	2.3	2.1	-23
1966	2.4	1.3	+ 4
1967	2.7		+12
1968	2.1	1.8	-22
1969	2.2	1.2	+ 5

[a] Equivalent to percent population change.

Data are presented here only for the years 1962 to 1969, the period of general population decline for which data were collected from the Vernon-Armstrong area. During this time there appears to be a negative correlation between the young/hen figure and the percent population change. A high autumn number of young per hen may have produced a greater estimated population decline, although the relationship is not statistically significant.

We do not have sufficient information to determine whether or not, during a population increase, a large positive population change is dependent upon a high number of young per hen during the fall.

APPENDIX D. Common and scientific names of plant and animal species mentioned in the text.

Common Name	Scientific Name
Ring-necked pheasant	*Phasianus colchicus* spp.
Caucasian pheasant	*Phasianus colchicus torquatus*
Mongolian pheasant	*Phasianus colchicus mongolicus*
Douglas fir	*Pseudotsuga menziesii*
Yellow pine	*Pinus ponderosa*
Bunchgrass	*Agropyron spicatum*
Sage brush	*Artemesia tridentata*
Greasewood	*Purshia tridentata*

APPENDIX E. Areas (ha) for the production of various crops in the Okanagan Region between 1911 and 1966 (Anon. 1911-1966).

Crop	1911	1921	1931	1941	1951[a]	1956[a]	1961[a]	1966
Total farmland	198,472	207,509	187,085	230,070	284,504	267,281	234,507	233,150
Total improved land	44,848	42,402	46,490	52,754	68,882	64,529	71,495	78,642
Under crops	25,695	35,154	36,680	39,968	42,832	44,756	46,508	49,988
field crops	18,085	26,049	26,063	27,618	28,771	29,987	32,341	35,368
grain	2,565	10,622	13,578	10,429	9,421	8,440	9,182	7,820
forage	10,622	13,298	15,369	16,202	18,279	19,566	21,647	26,152
roots	774	2,050	1,345	985	753	663	916	800
other	4,123	79	19	2	300	1,318	596	596
Market garden	904	-	1,599	1,769	1,346	1,179	910	971
Fruit	6,562	8,262	9,018	10,582	12,931	13,896	13,323	13,735
Fallow	894	3,514	3,004	2,706	2,252	2,537	1,822	2,269
Pasture	-	3,813	5,096	7,968	20,142	14,204	19,704	22,717
Other	18,258	-	1,710	2,111	3,655	3,032	3,462	3,668
Total unimproved land	153,624	165,107	140,595	177,316	215,622	202,752	163,012	154,508
Forest	117,675	79,053	68,272	62,072	67,220	44,570	56,196	41,638
Marsh or wasteland	10,896	14,389	13,491	16,454	148,402[b]	27,402	24,070	112,870[b]
Natural pasture	25,053	71,665	58,832	98,790		130,780	82,746	
Number of farms	3,370	3,871	4,161	4,424	5,265	5,158	4,460	4,271

[a] The "Under crops" area does not equal the total for individual crops as these were derived from different tables.

[b] Value is a total of Marsh or Wasteland and Natural pasture.

APPENDIX F. January-February winter counts of pheasants, Okanagan and lower Similkameen Valleys, 1952-1968.

Location	Date of count	Number of birds counted			Rooster:hen ratio
		rooster	hen	total	
Vernon /	Feb.1949			4630	
Armstrong	Feb.1950	114	603	717	1;5.3
	Dec. 22, 1953	20	109	129	1:5.5
	Feb. 10, 1955	102	360	462	1:3.5
	Feb. 10, 1959	211	1157	1368	1:5.5
	Jan.-Feb. 1961	119	452	571	1:3.8
	Jan. 1962	66	366	432	1:5.5
	[a]Jan. 13, 1963	216	996	1212	1:4.6
	[a]Jan. 19, 1963	141	844	985	1:6.0
	Jan. 2-3, 1964	61	575	636	1:9.4
	Feb. 6-7, 1964	90	700	790	1:7.8
	[a]Jan. 17, 1965	143	606	749	1:4.2
	Jan.-Feb. 1966	20	162	182	1:8.2
	Feb. 1-2, 1968	53	291	344	1:5.5
	Jan. 16, 1969	28	179	207	1:6.4
	Average				1:5.7
Kelowna	Jan. 18, 1952	42	82	124	1:2.0
	Jan. 1962	7	39	46	1:5.6
	Jan. 5, 1964	14	87	101	1:6.2
	Feb. 5, 1964	26	140	166	1:5.4
	Jan. 19, 1965	51	158	1 210	1:3.1
	Feb. 7-9, 1967	18	83	101	1:4.6
	Average				1:5.1
Oliver /	Jan. 15, 1952	29	37	66	1:1.3
Osoyoos	Jan. 1962	2	12	14	1:6.0
	Jan. 9, 1964	16	65	81	1:4.0
	Feb. 3, 1964	19	89	2 110	1:4.7
	Feb. 3, 1965	25	79	104	1:3.1
	Average				1:3.8
Keremeos /	Jan. 1962	29	28	57	1:1.0
Cawston	Feb. 4, 1964	8	27	35	1:3.4
	Feb. 2, 1965	20	33	53	1:1.5
	Average				1:1.5

[a] Counts made by Vernon & District Fish & Game Club.

APPENDIX G. Pheasant crowing counts, by date and area in the Okanagan Region, 1950 - 1969.

Area	Date	Duration (min)	Number of crowers	Number of stations	Birds/ station
Vernon	April 21, 1959	?	98	10	9.8
	May 6,8,17, 1963	3	172	23	7.5
	May 4,13,18, 1964	3	227	28	8.1
	May 3, 1965	2	62	11	5.6
	May 9,12,13,16, 1966	2	205	28	7.3
	May 4,5,6,7, 1967	2	318	28	11.4
	May 10,11,12,13, 1968	2	312	28	11.2
	May 5,6,7,8, 1968	2	295	29	10.2
Kelowna	May 5,6, 1964	2	145	19	7.6
	May 5,6, 1965	2	161	19	8.5
	May 6,8, 1966	2	244	21	11.6
	May 3,5, 1967	2	167	20	8.5
	May 8,9, 1968	2	200	20	10.0
	May 6,7, 1969	2	214	19	11.2
Oliver/ Osoyoos	May, 1951	2			12.5
	May, 1952	2			13.3
	May 5,21, 1953	2			9.7
	May 11,12, 1964	2	60	14	4.3
	May 10,11, 1965	2	54	14	3.9
	May 16,17, 1966	2	61	14	4.4
	May 7,8, 1969	2	28	14	2.0
Keremeos/ Cawston	May 5,21, 1953	2			11.3
	April 30, 1955	2			11.0
	May 14,15, 1964	2	36	14	2.6
	May 12,13, 1969	2	14	11	1.3

APPENDIX H. Road check data collected on opening of the pheasant season 1960 - 1969.

Year	Area	Birds checked: Total (roosters)	Ratio adults:young	No. of hunters	Hunter success birds/ hunter	Station check days
1960	Vernon	407	1:3.3	528	0.77	4
1961	"	450	1:6.3	484	0.93	6
1962	"	244	1:4.2	239	1.02	5
1963	"	342	1:5.1	372	0.92	4
1964	"	398	1:5.1	582	0.68	8
1965	"	396	1:4.5	690	0.58	7
1966	"	312	1:5.1	538	0.58	8
1967	"	301	1:4.6	478	0.63	8
1968	"	183	1:5.0	365	0.50	8
1969	"	272	1:3.8	402	0.66	8
	Average		1:4.8			
1963	Kelowna	85	1:1.4	140	0.6	6
1964	"	47	1:4.9	87	0.5	4
1965	"	106	1:3.5	192	0.52	4
[a] 1966	"	45		144	0.31	4
1967	"	30	1:3.2	67	0.45	4
1968	"	34	1:4.0	70	0.49	4
1969	"	44		83	0.53	4
	Average		1:2.8			
1960	Oliver/	45		87	0.52	2
1961	Osoyoos	24	1:5.0	67	0.36	2
1962	"	66	1:5.6	91	0.73	4
1963	"	52		113	0.46	4
1964	"	58		115	0.42	4
1965	"	16	1:4.3	45	0.36	2
[a] 1966	"	22	1:4.5	58	0.38	2
1967	"	10	1:4.0	60	0.17	2
[b] 1968	"	33	1:2.5	86	0.38	2
1969	"	20	1:1.5	56	0.36	2

[a] Starting at 10 A.M., rather than 8 A.M.

[b] Two cock birds, rather than 3 per day.

APPENDIX I. January minimum temperatures and total snowfall, winter weather factor, June mean daily temperature (Summerland), and General Weather Index.[a]

Year	January mean min. temp. (F°) (A)	January snow (in.) (B)	Winter weather factor (C)[b]	June mean daily temp. (D)	General Weather Index (C + D)
1949	7.7	7.0	0.7	62.2	62.9
1950	-3.6	9.0	-12.6	65.0	52.4
1951	19.7	11.6	8.1	63.6	71.7
1952	13.7	18.4	-4.7	60.9	56.2
1953	27.2	14.7	12.5	60.0	72.5
1954	16.4	12.1	4.3	58.6	62.9
1955	22.8	9.9	12.9	62.5	75.4
1956	23.6	12.3	11.3	60.8	72.1
1957	9.7	12.6	-2.9	63.5	59.6
1958	28.8	4.6	24.2	68.8	93.0
1959	21.5	17.4	-2.4	62.1	59.7
1960	20.5	6.8	13.7	64.1	77.8
1961	27.2	12.1	15.1	68.4	83.4
1962	20.2	5.9	14.3	62.2	76.5
1963	17.9	7.4	12.5	63.8	76.3
1964	27.8	9.0	18.8	62.8	81.6
1965	25.7	16.7	9.0	64.6	75.6
1966	23.9	11.3	12.6	60.6	73.2
1967	28.4	5.4	23.0	66.8	89.8
1968	24.1	6.3	17.8	61.9	79.7
1969	8.1	15.7	-7.6	69.6	62.0

[a] The General Weather Index is based on the British system since it could not be conveniently converted to metric.

[b] Calculated by A-B.

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